THE CALIFORNIA REPORT ON

CORONARY ARTERY

BYPASS GRAFT SURGERY

1999 Hospital Data

Technical Report

August 2003

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Additional copies of the Technical Report can be obtained through the PBGH (www.pbgh.org) and OSHPD (www.oshpd.state.ca.us) Web sites. PBGH posts the hospital performance results on its California Consumer HealthScope Web site (www.healthscope.org), a public source of information on healthcare quality for California consumers.

PREFACE

August 2003

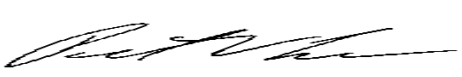
We are pleased to release ***The California Report on Coronary Artery Bypass Graft Surgery: 1999 Hospital Data*****,** the second report from the California Coronary Artery Bypass Graft (CABG) Mortality Reporting Program (CCMRP). The report reflects the continuation of an important partnership between the state, purchasers, and hospitals to voluntarily collect and release hospital performance data on mortality associated with coronary artery bypass graft surgery. In an environment of scarce resources, collaboration is critical.

Data on 70 of the 119 hospitals that regularly performed bypass surgery in 1999 are summarized in this report. These 70 hospitals performed approximately 68% of all isolated coronary artery bypass graft surgeries in California in 1999. For the 1999 analysis period, the overall in-hospital death rate for bypass surgery was 2.76% among the participating hospitals.

All 70 participating hospitals are to be commended for their explicit commitment to quality improvement—for which measurement and public accountability are requisite steps in the quality improvement process. The transparency of hospital performance information is critical to national efforts to close the quality gap identified in the Institute of Medicine's report *Crossing the Quality Chasm* (2001). Through concerted, collaborative efforts to measure and reduce performance variations, we can take concrete steps to ensure that the care provided by California hospitals is safe, effective, and efficiently delivered.

The important work of CCMRP over the last five years, which laid the foundation for public reporting of CABG outcomes and highlighted differences in death rates between participating and non-participating hospitals, set the stage for compulsory reporting of bypass surgery outcomes for hospitals and surgeons in California. The passage of Senate Bill 680 (Chapter 898, Statutes of 2001) replaces CCMRP with the California CABG Outcomes Reporting Program (CCORP) operated by OSHPD. CCORP begins its data reporting with the 2003 hospital data submission; meanwhile, CCMRP continues its work to close out the 2000-2002 data period.

Through this important partnership, our goal is to produce information that will be used to improve health outcomes for all patients who undergo bypass surgery, regardless of the hospital that they and their physicians select. To do so requires that we have knowledge about performance and that we apply this knowledge to drive improvements in the quality of care and reward those institutions that have demonstrated excellence in performance.



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SUMMARY

In 1995, the Pacific Business Group on Health (PBGH) and the California Office of Statewide Health Planning and Development (OSHPD) entered into a private-public sector partnership to establish a statewide reporting program for coronary artery bypass graft (CABG) surgery. The program, the **California CABG Mortality Reporting Program** (CCMRP), is a voluntary reporting system to produce in-hospital mortality results for California hospitals. The voluntary nature of CCMRP stands in contrast to the other statewide CABG reporting programs operated by New York, New Jersey, Pennsylvania, and Massachusetts, all of which mandate hospitals to collect and publicly report performance data. Only recently did California enact legislation that mandates the submission of hospital and surgeon CABG performance data for all hospitals commencing January 1, 2003.

The CCMRP **1999 Hospital Data Report** presents findings from analyses of data collected from 70 of California's 119 hospitals that regularly performed CABG surgery during 1999, and focuses on in-hospital mortality as the key outcome measure.[1] The report includes results for calendar year 1999 (**1999 Analysis**) and results that represent the roll-up of all continuous quarters of data submitted by hospitals since they joined CCMRP (**All Quarters Analysis**).[2] The **1999 Analysis** includes a total of 21,973 cases from all hospitals that submitted data to CCMRP for 1999, making it the largest public reporting program on CABG outcomes in the United States.

It is important to understand the reasons for the time lapse between the end of the analytic period (year-end 1999) and the publication date of this report. The process of collecting and cleaning clinical data, verifying the accuracy of hospital data submissions through audit and other cross validation procedures, running risk models and allowing hospitals to review results prior to publication is an iterative and time intensive process. Several factors contribute to the time lag including: 1) incomplete and often incorrect initial data submissions from hospitals which require substantial follow-up to correct; 2) slow responses by hospitals to CCMRP requests for data corrections; 3) an 18-month lag associated with the availability of the OSHPD Patient Discharge Data (PDD) to cross validate deaths and case counts from hospitals; and 4) time required to prepare the final report, allow for review of results by hospitals and the Technical Advisory Committee, and for final review and approval by the State prior to publication. At the time this report was published, other states with cardiac reporting programs had released reports displaying data from 1998, 1999, and 2000 (primarily those relying on administrative data to produce their reports).[3]

Key findings from the **1999 Analysis** are:

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[1] In-hospital mortality means that the patient expired prior to discharge from the hospital that performed this operation, regardless of length of stay. Deaths are not counted after discharge even if the patient dies soon after the operation. If a patient is transferred post-operatively to a rehabilitation or transitional care facility and dies before going home, this death is not counted.

[2] CCMRP began enrolling hospitals in the program starting January 1, 1997. Enrollment in the program was ongoing during the 1997-1999 period. As a result, hospitals continuously participating since their enrollment in the program will have different numbers for their "quarters of participation". The maximum number of quarters of participation for any one hospital is 12—representing full year participation in 1997, 1998, and 1999. The minimum number of quarters of participation required for inclusion in this report is four, representing full calendar year 1999. Results for 1997-1998 data can be found in the report published by CCMRP in July 2001.

[3] Reports from other states display data from: Texas (2000), Virginia (2000), Pennsylvania (2000), New York (1997-1999), New Jersey (1998).

- The overall in-hospital death rate in California among participating hospitals was 2.76% for 1999 (meaning slightly fewer than 3 deaths per 100 cases), as compared to 2.60% for 1997-1998. Nationally, the Society of Thoracic Surgeons reports an "operative mortality" rate for isolated bypass surgery of 2.90% for 1999.[4]

- Most California hospitals are performing within the range of what was expected. Sixty-seven out of the 70 hospitals performed "as expected," meaning that the actual death rates at these institutions were within range of what was expected given the complexity of cases they treated.

- Three of the 70 hospitals performed significantly "worse than expected," meaning their actual death rate was higher than expected given the complexity of cases they treated. The three hospitals were Desert Regional Medical Center, Marin General Hospital, and Scripps Mercy.

- None of the 70 hospitals performed significantly "better than expected," meaning that no hospital's actual death rate was lower than expected given the complexity of cases they treated. The fact that no hospitals are classified as "better than expected" is not too surprising given the low mortality rate associated with bypass surgery (fewer than 3 deaths for every 100 cases in 1999). The low death rate makes it very difficult for a hospital to distinguish itself as a "good" outlier (note: a hospital must operate on sick people and do well with these patients to achieve "better than expected" performance results). The problem of distinguishing "better than expected" performance is exacerbated by looking at a single year's worth of data, where confidence intervals can be quite wide for hospitals with low case volumes.

Other major findings in this report include:

- The overall in-hospital death rate in California among the 70 hospitals included in the **All Quarters Analysis** was 2.60%.

- The **All Quarters Analysis** revealed that five hospitals performed "better than expected," 59 hospitals performed "as expected," and six hospitals performed "worse than expected." The five hospitals that performed "better than expected" were: Doctor's Medical Center-San Pablo, Heart Hospital of the Desert, Scripps Memorial Hospital, Summit Medical Center, and Sutter Memorial Hospital. The six hospitals that performed "worse than expected" were: Alta Bates Medical Center, Desert Regional Medical Center, Marin General Hospital, Memorial Medical Center of Modesto, Presbyterian Intercommunity Hospital, and Scripps Mercy.

- The **All Quarters Analysis**, which is based on more than one year's mortality outcomes for the majority of hospitals[5], may allow more precision in evaluating each hospital's "true" performance. This is especially important in assessing outcomes for small volume hospitals, whose mortality experience tends to be more variable year-to-year (i.e., in making estimates from any period of data, the confidence intervals widen as the number of cases decreases).

[4] Operative mortality refers to 30-day mortality. Most deaths "in hospital" occur within 30 days. The "operative mortality" rate tends to be slightly higher than the "in hospital" mortality rate.

[5] Twelve hospitals began participation in 1999; their All Quarters rate thus reflects performance solely for that single year.

- Raw unadjusted mortality rates give a false impression of a hospital's relative performance, which underscores the importance of risk adjustment when producing performance ratings. When compared to unadjusted CCMRP results, the adjusted hospital results led to 17 changes in performance ratings among 81 hospitals.

- The expected death rate ranged from 1.2% to 5.4%, revealing wide variation among California hospitals with respect to the case mix of patients they treat. This underscores the importance of adjusting for differences in case mix to produce outcome scores.

- There was a high degree of agreement between the actual number of deaths and the predicted numbers of deaths from the risk-adjustment model. This means that the risk model gives hospitals appropriate credit for treating more complex cases. Consequently, hospitals and surgeons should not exclude high-risk patients from appropriate CABG surgeries as a means to improve performance scores.

- Our ongoing evaluation of the relationship between the volume of CABG procedures a hospital performs and in-hospital mortality continues to find wide variation in the performance of hospitals with relatively low case volumes (<300 cases) and less variation in the performance of hospitals with relatively high case volumes. From the **All Quarters Analysis**, we find that on average, CCMRP hospitals with mean annual volumes of 300 or more cases experienced statistically significantly lower mortality than hospitals with fewer than 200 cases annually. This finding raises concerns about the performance of hospitals whose results do not appear in this report, as 35 of the 49 non-participants had annual surgical volumes fewer than 200 cases.

- Based on data from OSHPD's PDD, the raw, unadjusted mortality rate for the 49 hospitals that decided not to participate in CCMRP was 3.34% in 1999, versus an unadjusted mortality rate of 2.73% for the 70 participants[6]. Of the 49 non-participants, 11 submitted usable data but were either dropped (2 hospitals) or withdrew (9 hospitals) prior to publication of this report. The raw, unadjusted in-hospital death rate for the 11 hospitals was 3.21%. Non-participants tended to have worse performance results than did participants, underscoring the need for compulsory reporting.

[6] Calculations of observed mortality rates differ slightly depending on the data source. When comparing CCMRP non-participating hospitals to CCMRP participants, it was necessary to utilize data from OSHPD's PDD. All other analyses are based on data submitted directly to CCMRP from participating hospitals.

ACKNOWLEDGEMENTS

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We wish to recognize the important contribution made by a host of individuals in each of the participating hospitals, who dedicated their scarce time and resources to collect and clean the data for analysis. We thank the participating hospitals for their ongoing feedback on the design of the program, which is vital to our efforts to improve our work. We are also grateful for the contributions made by the members of the CCMRP Technical Advisory Panel, who provide oversight and policy guidance in the collection, analysis and presentation of the results. CCMRP also continued to collaborate with the Society of Thoracic Surgeons and its California Chapter to coordinate and improve our data collection efforts.

The California CABG Mortality Reporting Program reflects the efforts and significant contributions of numerous individuals, including:

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GLOSSARY OF FREQUENTLY USED ACRONYMS

BMI	Body mass index
BSA	Body surface area
CABG	Coronary artery bypass graft
CASTS	California Chapter of the Society of Thoracic Surgeons
CCMRP	California Coronary Artery Bypass Graft (CABG) Mortality Reporting Program
CCORP	California CABG Outcomes Reporting Program (Mandatory)
CCS	Canadian Cardiovascular Society
CHF	Congestive heart failure
COPD	Chronic obstructive pulmonary disease
ICD-9-CM	International Classification of Diseases, 9th Revision, Clinical Modification
MI	Myocardial infarction
NYHA	New York Heart Association
O/E ratio	Observed to expected ratio
OSHPD	Office of Statewide Health Planning and Development
PBGH	Pacific Business Group on Health
PDD	Patient Discharge Database (OSHPD)
PTCA	Percutaneous transluminal coronary angioplasty
STS	Society of Thoracic Surgeons
TAP	Technical Advisory Panel (CCMRP)

I. INTRODUCTION

The California Coronary Artery Bypass Graft Mortality Reporting Program

The California Coronary Artery Bypass Graft Mortality Reporting Program (CCMRP) is a voluntary statewide hospital reporting program designed to collect and report coronary artery bypass graft (CABG) operative mortality at the hospital level. CCMRP produces uniform, hospital-level mortality rates, adjusted to account for differences across hospitals in the mix of patients undergoing CABG surgery. The project was established in 1995 by the Pacific Business Group on Health (PBGH), a statewide coalition of purchasers of care, and the Office of Statewide Health Planning and Development (OSHPD), the California state department responsible for reporting risk-adjusted hospital outcomes data. The California Chapter of the Society for Thoracic Surgeons (CASTS) and the national Society of Thoracic Surgeons (STS) assisted with the initial implementation of this program and they continue to provide input through the Technical Advisory Panel (TAP).

PBGH and OSHPD selected CABG surgery because it is a frequently performed and costly procedure. Based on data from OSHPD's 2001 Patient Discharge Database (PDD), 25,932 isolated[7] coronary artery bypass graft surgeries were performed at 119 California hospitals.[8] For 2001, the average hospital charge for a bypass procedure was approximately $129,770 (OSHPD, 2001).[9] For some hospitals, only births comprised a larger proportion of their total revenue.

A number of studies have examined the relationship between the volume of CABG surgeries and mortality. These studies find that, on average, mortality rates are higher at low volume hospitals as compared to high volume hospitals (Farley, 1992; Hannan et al., 1989; Hannan et al., 1991; Showstack et al., 1987; Dudley et al., 2000). While some low volume institutions do achieve good outcomes, there is particular concern for possible quality of care problems among the smallest volume hospitals. The Leapfrog Group, a national coalition of organizations dedicated to improving patient safety, established a volume threshold of 500 cases per year for hospitals performing bypass surgery, citing the clinical evidence supporting better outcomes at larger volume institutions (www.leapfroggroup.org, 2002). The American College of Cardiology ***Guidelines for Coronary Artery Bypass Graft Surgery*** (Eagle et al., 1999) note potential concern for hospitals and/or surgeons who perform fewer than 100 cases annually and recommend monitoring the performance of these institutions and surgeons. Surgical volume and its relationship to quality is a concern in California given the substantial number of hospitals with low annual CABG volumes. Figure 1 shows, for 1999, 70 out of the 119 California hospitals (59%) performed fewer than 200 surgeries. Of these 70 hospitals, 28 performed 100 or fewer surgeries annually. The performance of many low volume hospitals remains unknown, as they were less likely to participate in CCMRP.

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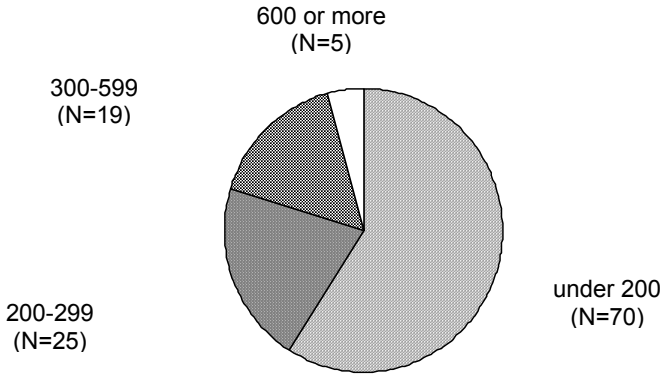
[7] Isolated means that no patient received both a CABG and an additional major procedure such as a valve repair or replacement during the same operation (see Appendix A for isolated CABG definition). Isolated CABG surgeries comprise the majority of heart operations in California and the U.S.

[8] All 119 hospitals performed at least 25 adult isolated CABG surgeries each during 1999.

[9] Source: 2001 OSHPD PDD. Calculations refer to total charges per discharge for all patients who had an isolated CABG procedure as defined in Table 1. The 2001 figure includes charges for CABG cases that may have had post-surgical complications and required other procedures or treatment during the same admission. It excludes 2,400 cases for 2001 where there was a $0 charge amount (i.e., Kaiser facilities). The calculation of the charge figure differs from that reported in the 1997-1998 CCMRP Technical Report, which only included charges for CABG surgeries without major complications. Few hospitals actually receive payment in the amount represented by charges. Reimbursement rates are negotiated between health plans and hospitals and typically are much lower than charges.

Figure 1: California Hospital Isolated CABG Surgery Volumes, 2001 OSHPD Patient Discharge Data



The Need for Comparative Outcomes Data

Individuals and employers—who often serve as purchasing agents for employee and dependent populations—face difficulties in making informed healthcare purchasing and treatment decisions. Rarely is comparative information on health outcomes readily available to help guide consumer and purchaser choice in the marketplace. Consequently, purchasing and treatment decisions typically are based on price alone and not on the overall value of services—a key component of which is the quality of care. Recent decisions by health plans to establish tiered hospital networks further underscore the importance of having reliable performance information. In the absence of outcomes data, plan decisions about which tier a hospital is placed into will be determined by price alone—which neither benefits patients nor rewards hospitals with better outcomes.

Most importantly in our efforts to promote the delivery of high quality care, there is a need among California hospitals and surgeons for comparative performance data. This type of information is lacking for all hospital procedures with the exception of bypass surgery and acute myocardial infarction. Performance information is vital to helping hospitals understand where quality of care problems may exist and to targeting improvement efforts. Measurement and public accountability are powerful stimuli in driving quality improvements in all sectors, including healthcare (Hibbard et al., 2003).

To make comparative quality information available to patients and purchasers, and to physicians and hospitals so they can engage in continuous quality improvement, PBGH and OSHPD established CCMRP. CCMRP reports, on a periodic basis, risk-adjusted mortality rates for isolated CABG surgery at each non-federal hospital in California that performs adult CABG surgery, has voluntarily agreed to provide data to the reporting system, and participates in an independent audit of these data.

In-hospital mortality was selected as a measure of hospital quality for isolated CABG surgery because it can be reliably measured and affords comparability across hospitals. It should be noted that mortality is not the only measure of the quality of bypass surgery. Process measures

and complications are also important quality indicators; however, these measures are difficult to ascertain in a reliable and consistent fashion across institutions to permit fair comparisons. The New York Department of Health's CABG reporting program has attempted the collection and comparison of complications data but found wide variation in reporting practices (i.e., significant under-reporting of complications) across hospitals, making uniform comparisons problematic.

Goals of CCMRP

CCMRP aims to provide comparative risk-adjusted mortality rates to:

- ***Hospitals and providers***: to stimulate and facilitate quality review of surgical procedures and processes of care that will lead to improved outcomes;
- ***Purchasers of care***: to promote public accountability and to incorporate quality measures into purchasing decisions; and
- ***Patients and their family members***: to understand differences in surgical outcomes across hospitals so that they can make more informed treatment decisions.

CCMRP Technical Advisory Panel

CCMRP has a Technical Advisory Panel comprised of cardiac surgeons, cardiologists, clinicians and health services researchers with expertise in quality of care and risk adjustment. Its role is to provide ongoing guidance to PBGH and OSHPD regarding the design and implementation of the program—including defining the outcome measure and purpose of the reporting program, selecting data elements, and providing recommendations regarding data collector training and data audits to ensure the quality of the data. Additionally, the advisory panel reviews and comments on the analysis plan, study findings, and the presentation of results.

Guide to Using this Report

Section II explains recruitment and participation of hospitals in the program. Section III describes the data selection, collection and verification processes undertaken in 1999. Section IV describes the methods CCMRP used to adjust hospital mortality data and tabulates the resulting risk-adjusted hospital mortality rates for 1999. Section V presents the risk model and risk-adjusted results for the aggregated data from 1997-1999. Section VI describes the model fit and calibration. Section VII explores the relationship between hospital volume and outcome for CABG procedures. Appendices A-G provide detailed technical and operations information. Not included in this report, but available through the OSHPD Web site is a detailed description of the 1999 medical records audit and the analyses of those data (www.oshpd.state.ca.us).

II. HOSPITAL PARTICIPATION

CCMRP depends on the voluntary participation of hospitals to produce comparative bypass surgery outcome results. Of 119 California hospitals performing adult CABG surgeries in 1999, 70 hospitals agreed to submit data, participate in the audit and publicly report their results, while 49 hospitals did not participate for various reasons (see Table 1).

Enrollment in CCMRP is ongoing and evolving. As part of the recruitment process, all hospitals that performed at least 25 adult CABG surgeries received multiple mailings and phone calls to enlist interest and participation between Fall 1996 and March 1999, including a final invitation letter sent by certified mail to the CEOs of non-participating hospitals. The letter provided a deadline for joining the program and indicated that hospitals declining to participate would be listed as such in the public report. Likewise, hospitals that wished to begin participation in the program with the 1999 data collection period were given a deadline for joining the program, beyond which they would be listed as declined to participate in the 1999 report.

Hospitals listed as participating agreed to:

- Report pre-operative risk factors and mortality data for all isolated CABG surgeries performed during the calendar year (a hospital was not permitted to participate if it chose to submit only a portion of its caseload);
- Participate in a training session designed to improve consistency in coding practices across hospitals;
- Submit data on a quarterly basis using a standard data entry format and standard variable definitions;
- Participate in an independent medical records audit to verify data quality; and,
- Publicly release their risk-adjusted mortality rates.

Figure 2 depicts the steps in the recruitment, data collection, verification, and analysis phases of the project and the number of hospitals at each phase for the 1999 data analysis period. After the initial recruitment phase, there were several points in the program where hospital attrition occurred.

Figure 2: Summary of Hospital Participation in 1999 CCMRP Data Reporting Program

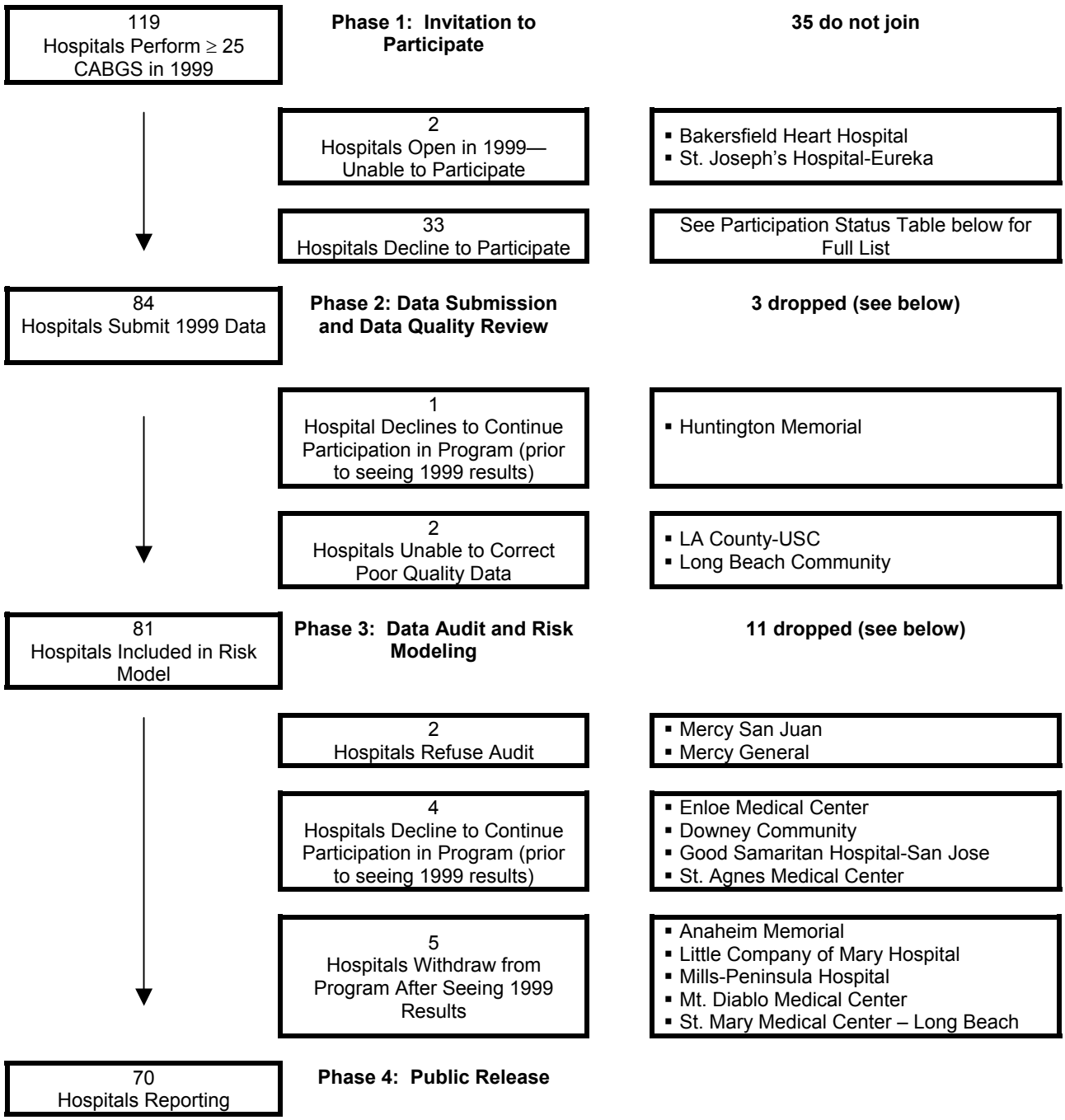


Table 1 lists the 119 hospitals in California that performed at least 25 adult isolated CABG surgeries in calendar year 1999 and their final participation status the in 1999 CCMRP data report. The following information is shown for each institution:

- 1999 data reporting period participation status;
- Region in which the hospital is located;

- Total number of heart surgeries performed;
- Total number of isolated CABG surgeries; and,
- Percent of all heart surgeries that isolated CABG surgeries represent at that institution.

The number of heart procedures and isolated CABG surgeries shown in Table 1 are derived from OSHPD's Patient Discharge Database (PDD), using definitions based on International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. The numbers of isolated CABG surgeries in Table 1 will not exactly match those provided to CCMRP by participating hospitals, as submissions to CCMRP were based on a clinical definition of an isolated CABG surgery.

The following categories were used to define participation status for the 1999 data-reporting period. The table also shows the number and percentage of hospitals that fall into each category.

Key to Table 1

Participation Status	Definition	Number	Percentage
Participating	Hospital submitted data to CCMRP and publicly released results based on a minimum of all four quarters in 1999.	70	58%
Declined to Participate	Hospital did not participate in CCMRP's 1999 public reporting period.	38	32%
Withdrew from Program	Hospital submitted a complete set of data for 1999, but elected to withdraw after viewing their results for 1999.	5	4%
Dropped-Refused Audit	Hospital refused to undergo an audit of their data and was dropped from public reporting.	2	2%
Dropped-Poor Quality Data	Hospital was unable to provide complete and accurate data and was dropped from the analysis.	2	2%
Opened in 1999	Hospital initiated its cardiac surgery program during 1999 and did not have a complete set of data for 1999.	2	2%
Total Number of Hospitals		119	100%

Table 1: California Hospitals that Perform Adult CABG Surgeries: 1999 CCMRP Participation Status and Volume of Heart and Isolated CABG Surgeries

Hospital	CCMRP Participation Status in 1999 Program	Region	Number of Heart Surgeries*	Number of Isolated CABG Surgeries*	Isolated CABG Cases as a % of All Heart Surgeries
Alta Bates Medical Center	Participating	San Francisco Bay Area and San Jose	145	96	66.2
Alvarado Hospital Medical Center	Participating	Greater San Diego	188	147	78.2
Anaheim Memorial Hospital	Withdrew from Program	Orange County	181	133	73.5
Antelope Valley Hospital Med Ctr	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	56	45	80.4
Bakersfield Heart Hospital	Opened in 1999	Central California	56	47	76.8
Bakersfield Memorial Hospital	Declined to Participate	Central California	466	342	73.4
Beverly Hospital	Declined to Participate	Greater Los Angeles	41	38	92.7
Brotman Medical Center	Declined to Participate	Greater Los Angeles	93	83	89.2
California Pacific Medical Center	Participating	San Francisco Bay Area and San Jose	321	169	52.6
Cedars-Sinai Medical Center	Participating	Greater Los Angeles	697	351	50.4
Centinela Hospital Medical Center	Declined to Participate	Greater Los Angeles	112	66	58.9
Community Memorial Hospital - San Buenaventura	Participating	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	249	187	75.1
Dameron Hospital	Participating	Central California	129	110	85.3
Daniel Freeman Memorial Hospital	Participating	Greater Los Angeles	220	154	70.0
Desert Regional Medical Center	Participating	Inland Empire, Riverside, and San Bernardino	170	135	79.4
Doctors Medical Center - Modesto	Participating	Central California	624	515	82.5
Doctor's Medical Center - San Pablo	Participating	San Francisco Bay Area and San Jose	99	83	83.8
Dominican Santa Cruz Hospital	Participating	San Francisco Bay Area and San Jose	210	159	75.7
Downey Community Hospital	Declined to Participate	Greater Los Angeles	145	106	73.1
Eisenhower Medical Center	Declined to Participate	Inland Empire, Riverside, and San Bernardino	164	123	75.0
El Camino Hospital	Participating	San Francisco Bay Area and San Jose	155	111	71.6

Table 1: California Hospitals that Perform Adult CABG Surgeries: 1999 CCMRP Participation Status and Volume of Heart and Isolated CABG Surgeries

Hospital	CCMRP Participation Status in 1999 Program	Region	Number of Heart Surgeries*	Number of Isolated CABG Surgeries*	Isolated CABG Cases as a % of All Heart Surgeries
Enloe Medical Center	Declined to Participate	Sacramento Valley and Northern California	258	210	81.4
Fountain Valley Regional Hospital and Medical Center - Euclid	Declined to Participate	Orange County	189	161	85.2
French Hospital Medical Center	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura, Santa Barbara	325	263	80.9
Fresno Community Hospital and Medical Center	Declined to Participate	Central California	494	378	76.5
Garfield Medical Center	Declined to Participate	Greater Los Angeles	112	97	86.6
Glendale Adventist Medical Center - Wilson Terrace	Participating	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	308	268	87.0
Glendale Memorial Hospital and Health Center	Participating	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	218	181	83.0
Good Samaritan Hospital – San Jose (Columbia)	Declined to Participate	Greater San Francisco Bay Area and San Jose	544	406	74.6
Granada Hills Community Hospital	Participating	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	84	71	84.5
Green Hospital of Scripps Clinic	Participating	Greater San Diego	314	226	72.0
Heart Hospital of the Desert	Participating	Inland Empire, Riverside, and San Bernardino	118	87	73.7
Hoag Memorial Hospital Presbyterian	Participating	Orange County	370	252	68.1
Huntington Memorial Hospital	Declined to Participate	Greater Los Angeles	440	305	69.3
Inter-Community Medical Center – Citrus Valley	Declined to Participate	Greater Los Angeles	200	173	86.5
John Muir Medical Center	Participating	San Francisco Bay Area and San Jose	167	124	74.3
Kaiser Foundation Hospital – Los Angeles (Sunset)	Participating	Greater Los Angeles	2016	1603	79.5

Table 1: California Hospitals that Perform Adult CABG Surgeries: 1999 CCMRP Participation Status and Volume of Heart and Isolated CABG Surgeries

Hospital	CCMRP Participation Status in 1999 Program	Region	Number of Heart Surgeries*	Number of Isolated CABG Surgeries*	Isolated CABG Cases as a % of All Heart Surgeries
Kaiser Foundation Hospital – San Francisco (Geary)	Participating	San Francisco Bay Area and San Jose	1800	1280	71.1
Kaweah Delta District Hospital	Participating	Central California	482	402	83.4
Lakewood Regional Medical Center	Declined to Participate	Greater Los Angeles	246	215	87.4
Lancaster Community Hospital	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	32	25	78.1
Little Company of Mary Hospital	Withdrew from Program	Greater Los Angeles	268	167	62.3
Loma Linda University Medical Center	Participating	Inland Empire, Riverside, and San Bernardino	758	375	49.5
Long Beach Community Hospital	Dropped – Poor Quality Data	Greater Los Angeles	130	106	81.5
Long Beach Memorial Medical Center	Participating	Greater Los Angeles	565	362	64.1
Los Angeles County – USC Med Ctr	Dropped – Poor Quality Data	Greater Los Angeles	283	129	45.6
Los Angeles County Harbor – UCLA	Declined to Participate	Greater Los Angeles	246	167	67.9
Los Robles Regional Medical Center	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	376	282	75.0
Marian Medical Center	Declined to Participate	Central California	116	96	82.8
Marin General Hospital	Participating	San Francisco Bay Area and San Jose	91	69	75.8
Memorial Medical Center – Modesto	Participating	Central California	353	291	82.4
Mercy General Hospital	Dropped - Refused Data Audit	Sacramento Valley and Northern California	1566	1055	67.4
Mercy Medical Center – Redding	Participating	Sacramento Valley and Northern California	278	210	75.5
Mercy San Juan Hospital	Dropped - Refused Data Audit	Sacramento Valley and Northern California	255	186	72.9
Methodist Hospital of Southern California	Participating	Greater Los Angeles	314	262	83.4

Table 1: California Hospitals that Perform Adult CABG Surgeries: 1999 CCMRP Participation Status and Volume of Heart and Isolated CABG Surgeries

Hospital	CCMRP Participation Status in 1999 Program	Region	Number of Heart Surgeries*	Number of Isolated CABG Surgeries*	Isolated CABG Cases as a % of All Heart Surgeries
Mills-Peninsula Medical Center	Withdrew from Program	San Francisco Bay Area and San Jose	189	137	72.5
Mission Hospital and Regional Medical Center	Participating	Orange County	284	235	82.7
Mt. Diablo Medical Center	Withdrew from Program	San Francisco Bay Area and San Jose	628	505	80.4
Northridge Hospital Medical Center	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	164	132	80.5
O'Connor Hospital – San Jose	Declined to Participate	Greater San Francisco Bay Area and San Jose	141	105	74.5
Palomar Medical Center	Participating	Greater San Diego	169	128	75.7
Pomona Valley Hospital Med Ctr	Declined to Participate	Inland Empire, Riverside, and San Bernardino	329	271	82.4
Presbyterian Intercommunity Hospital	Participating	Greater Los Angeles	94	72	76.6
Providence Holy Cross Med Ctr	Participating	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	141	108	76.6
Providence St. Joseph Med Ctr	Participating	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	282	192	68.1
Queen of the Valley Hospital – Napa	Declined to Participate	Greater San Francisco Bay Area and San Jose	152	122	80.3
Redding Medical Center	Participating	Sacramento Valley and Northern California	712	538	75.6
Riverside Community Hospital	Declined to Participate	Inland Empire, Riverside, and San Bernardino	479	383	80.0
Saddleback Memorial Medical Center	Participating	Orange County	175	128	73.1
Salinas Valley Memorial Hospital	Participating	San Francisco Bay Area and San Jose	389	323	83.0
San Antonio Community Hospital	Participating	Inland Empire, Riverside, and San Bernardino	155	118	76.1

Table 1: California Hospitals that Perform Adult CABG Surgeries: 1999 CCMRP Participation Status and Volume of Heart and Isolated CABG Surgeries

Hospital	CCMRP Participation Status in 1999 Program	Region	Number of Heart Surgeries*	Number of Isolated CABG Surgeries*	Isolated CABG Cases as a % of All Heart Surgeries
San Joaquin Community Hospital	Declined to Participate	Central California	398	296	74.4
San Jose Medical Center	Participating	Greater San Francisco Bay Area and San Jose	113	83	73.5
Santa Barbara Cottage Hospital	Participating	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	421	278	66.0
Santa Clara Valley Medical Center	Declined to Participate	Greater San Francisco Bay Area and San Jose	110	87	79.1
Santa Monica – UCLA Medical Center	Participating	Greater Los Angeles	80	59	73.8
Santa Rosa Memorial Hospital	Participating	San Francisco Bay Area and San Jose	284	206	72.5
Scripps Memorial Hospital – La Jolla	Participating	Greater San Diego	693	428	61.8
Scripps Mercy	Participating	Greater San Diego	343	255	74.3
Sequoia Hospital	Participating	San Francisco Bay Area and San Jose	553	238	43.0
Seton Medical Center	Participating	San Francisco Bay Area and San Jose	589	483	82.0
Sharp Chula Vista Medical Center	Participating	Greater San Diego	343	287	83.7
Sharp Grossmont Hospital	Participating	Greater San Diego	191	146	76.4
Sharp Memorial Hospital	Participating	Greater San Diego	482	254	52.7
St. Agnes Medical Center	Declined to Participate	Central California	492	357	72.6
St. Bernardine Medical Center	Participating	Inland Empire, Riverside, and San Bernardino	704	554	78.7
St. Francis Medical Center	Participating	Greater Los Angeles	111	92	82.9
St. Helena Hospital	Participating	San Francisco Bay Area and San Jose	301	256	85.0
St. John's Hospital and Health Center – Santa Monica	Participating	Greater Los Angeles	215	152	70.7
St. John's Regional Medical Center -- Oxnard	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	201	146	72.6

Table 1: California Hospitals that Perform Adult CABG Surgeries: 1999 CCMRP Participation Status and Volume of Heart and Isolated CABG Surgeries

Hospital	CCMRP Participation Status in 1999 Program	Region	Number of Heart Surgeries*	Number of Isolated CABG Surgeries*	Isolated CABG Cases as a % of All Heart Surgeries
St. Joseph Hospital – Eureka	Opened in 1999	Central California	68	61	89.7
St. Joseph Hospital – Orange	Participating	Orange County	391	303	77.5
St. Joseph's Medical Center – Stockton	Participating	Central California	356	277	77.8
St. Jude Medical Center	Participating	Orange County	370	294	79.5
St. Mary Med. Center – Long Beach	Withdrew from Program	Greater Los Angeles	115	76	65.1
St. Mary Regional Medical Center – Apple Valley	Declined to Participate	Inland Empire, Riverside, and San Bernardino	205	169	82.4
St. Mary's Medical Center – San Francisco	Participating	Greater San Francisco Bay Area and San Jose	649	566	87.2
St. Vincent Medical Center	Participating	Greater Los Angeles	416	277	66.6
Stanford University Hospital	Participating	San Francisco Bay Area and San Jose	643	224	34.8
Summit Medical Center	Participating	San Francisco Bay Area and San Jose	291	195	67.0
Sutter Memorial Hospital	Participating	Sacramento Valley and Northern California	1028	639	62.2
The Hospital of the Good Samaritan Hospital – Los Angeles	Participating	Greater Los Angeles	938	648	69.1
Torrance Memorial Medical Center	Participating	Greater Los Angeles	351	213	60.7
Tri-City Medical Center	Participating	Greater San Diego	250	185	74.0
UC San Diego University Medical Center – Hillcrest	Declined to Participate	Greater San Diego	184	31	16.8
UC San Diego University Medical Center – Thornton	Declined to Participate	Greater San Diego	224	68	30.4
UCLA Medical Center	Participating	Greater Los Angeles	749	199	26.6
UCSF Medical Center	Participating	San Francisco Bay Area and San Jose	633	135	21.3
University of California Davis Medical	Participating	Sacramento Valley and Northern	295	166	56.3

Table 1: California Hospitals that Perform Adult CABG Surgeries: 1999 CCMRP Participation Status and Volume of Heart and Isolated CABG Surgeries

Hospital	CCMRP Participation Status in 1999 Program	Region	Number of Heart Surgeries*	Number of Isolated CABG Surgeries*	Isolated CABG Cases as a % of All Heart Surgeries
Center		California			
University of California Irvine Medical Center	Participating	Orange County	101	65	64.4
USC University Hospital	Participating	Greater Los Angeles	234	105	44.9
Valley Presbyterian Hospital	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura, and Santa Barbara	77	66	85.7
Washington Hospital – Fremont	Participating	San Francisco Bay Area and San Jose	202	170	84.2
West Anaheim Medical Center	Declined to Participate	Orange County	65	59	90.8
West Hills Regional Medical Center	Declined to Participate	San Fernando Valley, Antelope Valley, Ventura & Santa Barbara	90	75	83.3
Western Medical Center – Anaheim	Declined to Participate	Orange County	237	196	82.7
Western Medical Center – Santa Ana	Declined to Participate	Orange County	124	95	76.6
White Memorial Medical Center	Declined to Participate	Greater Los Angeles	117	99	84.6
Total All Hospitals			39,549	27,641	69.9

*Source: Excludes three Veterans Administration Hospitals in Los Angeles, San Diego, and San Francisco that also perform CABG surgeries. For this table, counts of surgical procedures are calculated from the patient's date of discharge from a hospital (that is, a patient receiving a CABG surgery on December 30, 1999 who was discharged on January 3, 2000 is counted among 2000 discharges). The source of the numbers listed in the tables above is the Office of Statewide Health Planning and Development (OSHPD) PDD, which contains billing/administrative codes for all discharges from California hospitals. These numbers may not match the number of isolated CABG surgeries submitted to CCMRP by hospitals, which are based on a clinical definition of isolated CABG surgery.

Number of Heart Surgeries calculated using the following ICD-9-CM codes: 35.10, 35.11, 35.12, 35.14, 35.20, 35.21, 35.22, 35.23, 35.24, 35.27, 35.28, 35.31, 35.32, 35.33, 35.39, 35.51, 35.53, 35.61, 35.62, 35.71, 35.93, 36.03, 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.17, 36.19, 36.91, 36.99, 37.32, 37.4x, 37.65, 37.66, 39.61.

Number of Isolated CABG surgeries calculated using the following ICD-9-CM codes: Any record with 36.1x, excluding the following: 35.1x, 35.2x, 35.3x, 35.4x, 35.5x, 35.6x, 35.7x, 35.8x, 35.9x, 37.32, 37.35, 37.5x, 37.67, 38.10, 38.11, 38.12, 38.14, 38.15, 38.44, 38.45, 39.21, 39.22, 39.23, 39.24, 39.25, 39.26, 39.28, 39.51, 39.52, 39.53, 39.54, 39.55, 39.59, V433, provided the date of the CABG 36.1x procedure and excluded procedure occurred on the same day.

Comparison of CCMRP Participants and Non-Participants

A direct comparison of risk-adjusted mortality rates between CCMRP participants and non-participants is not possible because non-participants did not submit clinical data. However, based on OSHPD hospital PDD abstracts for the year 1999, the 70 participating hospitals performed a total of 18,701 isolated CABG surgeries, while non-participants performed a total of 8,940 cases. Table 2 provides a comparison of the number of isolated CABG surgeries and the "raw" or unadjusted death rate for participating and non-participating hospitals based on the PDD. In all but one volume category, the unadjusted "raw" observed death rate is higher among the non-participating hospitals. There are significantly more deaths in non-participating hospitals: a comparison of the death rate overall among non-participating hospitals (3.34) versus participating hospitals (2.73) finds this difference to be statistically significant at a p-value <0.05.[10]

Table 2: Comparison of Unadjusted Mortality Rates for Participating Hospitals and Non-Participating Hospitals, 1999 OSHPD PDD

Volume	Participants				Non-Participants			
	Number Hospitals	Cases	Deaths	Death Rate	Number Hospitals	Cases	Deaths	Death Rate
under 200	35	4528	149	3.29	35	3,672	148	4.03
200 to 299	19	4,803	160	3.33	6	1,537	51	3.32
300 to 599	12	5,200	116	2.23	7	2,676	95	3.55
600 or more	4	4,170	86	2.06	1	1,055	5	0.47
Total	70	18,701	511	2.73[11]	49	8,940	299	3.34

[10] The p-value was 0.0054 based on Fisher's exact test for the differences in events in participating and non-participating hospitals.

[11] This number differs slightly from the observed mortality rate of 2.76% for CCMRP participating hospitals reported elsewhere in the report. The rate of 2.73% is based on OSHPD patient discharge data (utilizing ICD-9-CM codes to determine isolated CABGs), while 2.76% is based on data submitted directly to CCMRP by each participating hospital (using a clinical definition of isolated CABGs).

III. DATA

CCMRP staff reviewed the clinical literature on pre-operative risk factors for bypass surgery and examined variables collected by the leading cardiac reporting programs to inform data collection for the program. CCMRP also reviewed a consensus statement prepared by a panel of researchers from the major CABG reporting programs that was particularly valuable in identifying those pre-operative characteristics of the patient that were most predictive of mortality (Jones et al., 1996). Appendix B contains a list of the variables identified in the consensus statement. Readers are directed to the ***California Report on Coronary Artery Bypass Graft Surgery: 1997-1998 Hospital Data Technical Report*** (July, 2001) for additional background on variable selection. Each year the data elements are reviewed and changes are made after consultation with the Technical Advisory Panel.

With some clarifications, CCMRP draws on a subset of data elements collected by the Society of Thoracic Surgeons (STS) for their National Database of Cardiac Surgery. Although the STS and CCMRP data definitions are virtually identical, CCMRP provides guidelines on interpretation of the definitions to assist hospitals with coding (see Appendix C). To improve the quality and comparability of data submitted across hospitals, CCMRP asks that each hospital receive training prior to beginning data submissions to CCMRP.

Table 3: CCMRP Data Elements, 1999*

1. Date of Surgery	2. Gender
3. Date of Birth	4. Race/Ethnicity (STS: Race)
5. Insurer (STS: Payor)	6. Patient's Zip Code
7. Height	8. Weight
9. Creatinine Level (Pre-operative)	10. Hypertension (Yes/No)
11. Dialysis (Yes/No)	12. Diabetes (Yes/No)
13. Peripheral Vascular Disease (Yes/No)	14. Cerebrovascular Disease (Yes/No)
15. Ventricular Arrhythmia (Yes/No)	16. Myocardial Infarction (MI) (Yes/No)
17. Date/Time of Most Recent MI (STS: MI When) (<=6 hrs., >6 but < 24 hrs., 1-7 days, 8-21 days, >21 days)	18. Number of Prior Cardiac Operations Requiring Cardiopulmonary Bypass
19. Date of Most Recent Cardiac Operation (STS: Previous CV Intervention: Most Recent)	20. Number of Prior PTCAs
21. PTCA/Atherectomy During Current Admission (STS: Prior PTCA including current admission)	22. PTCA to Surgery Time Interval (<=6hrs or >6hrs)
23. Chronic Obstructive Pulmonary Disease (Yes/No)	24. Congestive Heart Failure (Yes/No)
25. Angina (Yes/No)	26. Unstable Angina (Yes/No) (STS: Angina type: stable/unstable)
27. NYHA CHF Class	28. CCS Angina Class
29. Acuity (STS: Status) (elective, urgent, emergent, salvage)	30. Ejection Fraction (%)
31. Method of Measuring Ejection Fraction (LV Gram, radionuclide, or echocardiogram)	32. Left Main Stenosis (%)

33. Number of Diseased Vessels (None/Single/Double/Triple)	34. Mitral Insufficiency
35. Cross Clamp Time	36. Perfusion Time
37. Internal Mammary Artery (IMA) Used (Yes/No)	38. Cardioplegia (Yes/No)
39. Date of Discharge	40. Patient Status at Discharge (Alive/Dead)
41. Date of Death	

*See Appendix C for data element definitions

Hospital Data Submissions

Eighty-one hospitals initially submitted 21,973 usable records to CCMRP for the **1999 Analysis**. Sixty-eight of the 81 hospitals had previously submitted data for all or parts of 1997 and/or 1998.[12] As such, the combined rolled-up data across multiple years (1997-1999 **All Quarters** dataset) represents a total of 49,823 cases, with approximately 21% of the total cases from 1997 (10,391), 35% from 1998 (17,459), and 44% from 1999 (21,973).

The total number of cases submitted by each hospital varies across hospitals as a function of the size of the hospital and the date they commenced continuous participation in CCMRP. In other words, only records from hospitals that submitted continuously throughout the year with no submission "breaks" were included in the analyses. All hospitals shown in this report submitted data for a minimum of all four quarters of 1999. Appendix D presents a breakdown of each hospital's quarterly submissions.

Data Quality Review and Verification

CCMRP evaluated the data submitted from each hospital for completeness and potential data errors. The key steps involved in data cleaning and verification were:

- Step 1: Production and dissemination of hospital-specific data summary reports highlighting coding issues for clean-up;
- Step 2: Comparison of isolated CABG case volumes in CCMRP submissions with those in the OSHPD Patient Discharge Data (PDD);
- Step 3: Audit of a subset of cases at 36 hospitals and replacement of missing/inconsistent data with audited data;
- Step 4: CCMRP record linkage to the OSHPD PDD to evaluate accuracy of isolated CABG case submission and patient *Discharge Status* (alive/dead), with phone follow-up to hospitals to resolve resulting issues; and
- Step 5: Imputation of missing or invalid data values.

Hospitals that either refused audit (n=2) or had significant data problems that they were unable to fix (n=2) were dropped from the program.

Step 1: Hospital-Specific Data Summaries

Upon receipt of data at OSHPD, a "Quick Review Data Quality Check" form was filled out by the CCMRP Data Manager and immediately mailed to the hospital (see Appendix E). This one-page document noted potential problems based on a visual review of the distribution of data

[12] Enrollment in CCMRP is ongoing and hospitals can join at any time. Consequently, participants have varying numbers of quarters of data submissions, depending on the date they joined CCMRP.

element values in the dataset. Questionable cases were enumerated in a pre-printed list categorized into three problem types: missing data, logic problems, and out-of-range values. Hospitals were asked to immediately correct any problems noted and/or respond with additional explanatory information.

After receipt of all hospitals' 1999 full year data, hospitals were mailed a CCMRP Data Quality Report (DQR) (see Appendix F for item numbers 2 & 3 below). This report provides a detailed synopsis of the data received from each hospital, and compares each hospital's data submission with the aggregated data submitted by all hospitals during the time period. The DQR consisted of:

1. A cover letter explaining the report and its attachments.
2. A side-by-side univariate comparison (means and frequency distributions) of a given hospital's risk factors with those of all California hospitals submitting data to CCMRP.
3. A patient-level report detailing suspected errors based on data range checks, relational data edits, and missing critical data values.
4. A list of suspected duplicate records, when applicable.
5. A list of the hospital's inpatient deaths for the period.
6. Other pertinent program information, including definitions and imputation rules.

All hospitals received at least one DQR for the full 1999-year period, and most hospitals received more than one. Although the majority of hospitals made data corrections in response to coding issues identified in the DQRs, several hospitals did not respond, in spite of repeated requests by CCMRP staff.

Step 2: Comparison of Isolated CABG Cases: CCMRP vs. Patient Discharge Data
Corrections to CCMRP data based on the DQRs revealed hospital confusion concerning the CCMRP definition of an isolated CABG. A concern arose that hospitals were erroneously submitting non-isolated CABG cases to the program, and/or omitting cases from their CCMRP submission that were in fact isolated CABG surgeries. CCMRP's ability to evaluate this problem was limited by two factors: 1) the lack of a unique patient identifier with which to link CCMRP and PDD records (which represent all California hospital discharges) and, 2) the lack of an ICD-9-CM based definition of isolated CABG that could be employed to identify the target population in PDD.

As an interim step, staff compared each hospital's volume of isolated CABG cases as reported in the PDD (using a preliminary ICD-9-CM procedure code-based definition) with the number of cases submitted to CCMRP. This was done without linkage of records and without a formally tested and evaluated definition of isolated CABG based on ICD-9-CM codes.

Staff identified all hospitals with discrepancies between the two data sources that totaled more than 20 cases, or at least 10% of the hospital's volume. Thirteen hospitals met this criterion and were asked to explain the discrepancy. Ten of the thirteen hospitals discovered significant problems with their original submissions and subsequently made adjustments. In most cases, non-isolated CABG cases were eliminated from their submissions. Three hospitals maintained that no errors had occurred. Staff concluded that imprecision in the ICD-9-CM based definition of isolated CABG was likely responsible for these latter discrepancies.

Step 3: Data Replacements Using Medical Records Audit Data
Following preliminary data cleaning and analysis, CCMRP developed and implemented an audit process designed to formally review the quality of the data submitted for 1999. A subset of

cases at 36 of the 84 hospitals that originally submitted 1999 data were audited, representing 43% of hospitals submitting 1999 data and 12% of all usable records submitted to CCMRP.[13] The purpose and results of the audit are discussed briefly in the section below, **Audit of 1999 Data**, and in much greater detail in the ***California Report on Coronary Artery Bypass Graft Surgery 1999 Data, Technical Appendix: Audit Summary 2003*** (see www.oshpd.state.ca.us).

Auditor-abstracted data replaced the original hospital submission in the final model when data values recorded by auditors differed from those in the hospital's original submission. That is, for all data elements except *Discharge Status* (alive versus dead), the information submitted by the hospital was replaced by the information obtained in the audit. Our analysis of the audited data showed that this approach led to both improved risk model performance and improved data quality for audited hospitals.

The vast majority of audit data changes involved replacing missing values submitted by the hospitals with non-missing information obtained through the audit, though disagreement in coding of data elements at particular hospitals and across all hospitals was also noted. Additionally, the audit was used to verify that the cases selected for review were in fact isolated CABG surgeries. Audit results to the contrary (44 cases) were reviewed by CCMRP's medical consultant and, in all but five cases, resulted in removal of the record from the CCMRP analytic file.

Auditors sometimes had problems locating clear evidence of patient death in the medical charts alone. Findings of in-hospital death in OSHPD's PDD had proved highly reliable in previous studies, so PDD was considered the gold standard for recording patient deaths (Meux, 1990). This decision was validated by a subsequent CCMRP investigation into discrepancies in the coding of death among the PDD, CCMRP submission and audit findings at specific hospitals.

Step 4: Record-Specific Linkage of CCMRP Data with Patient Discharge Data Linkage
The audit revealed widespread problems with hospitals' coding of patient discharge status and interpretation of the definition of isolated CABG. CCMRP decided to conduct a linkage of the CCMRP dataset with the PDD in order to maximize the validity of the final results. Specifically, CCMRP records were linked, via a probabilistic matching algorithm[14], to all Patient Discharge Data records classified as Major Diagnostic Category 5 (MDC 5), Diseases and Disorders of the Circulatory System, as well as any records with ICD-9-CM code 36.1x in non-MDC 5 records. Also, an improved ICD-9-CM code-based definition of isolated CABG was developed to delineate those PDD records that could be isolated CABG surgeries.

CCMRP used this matched dataset to generate hospital reports when any of the three following conditions applied to patients whose *Discharge Status* was "dead" in either the PDD or CCMRP dataset:

1. There was a discrepancy in the discharge status of the patient between PDD and CCMRP (dead vs. alive).
2. An apparent isolated CABG mortality found in the hospital's PDD was not submitted to CCMRP (unreported death).
3. An apparent non-isolated CABG mortality was submitted to CCMRP (over-reported death).

[13] CCMRP audited all outlier hospitals identified at the time of the audit. During and subsequent to the audit, several hospitals either submitted data or replaced existing data with corrected information.

[14] A description of the methodology and mechanics of the data linkage are available from CCMRP upon request.

A total of 45 hospitals had cases meeting at least one of the above conditions. With regard to the first condition, CCMRP identified 17 cases in which patient *discharge status* was recorded as "dead" in the PDD, but reported as "alive" in the CCMRP submission. Alternatively, CCMRP also identified seven cases in which discharge status was recorded as "alive" in the PDD or the audit, but *discharge status* was recorded as "dead" in the CCMRP submission. The relevant hospitals were contacted and asked to review the specific cases. In all cases, the *discharge status* recorded in the PDD was found to be the correct information, and *discharge status* was appropriately re-coded.

For the second condition, 66 deaths from 32 hospitals were identified in the PDD as isolated CABG surgeries, but these cases were not found in the CCMRP submissions. In all cases, the hospital was contacted to explain the omission. Ultimately, 24 of the 66 records were confirmed as isolated CABG surgeries and submitted to CCMRP.

Regarding the third condition, eight deaths submitted to CCMRP from three hospitals could not be found in the PDD, or the PDD included ICD-9-CM codes suggesting that the cases were not isolated CABG surgeries. The hospitals were asked to review these cases and seven of the eight records were confirmed by the hospitals to be isolated CABG mortalities. The eighth record was found to have an incorrectly coded date of birth and was subsequently matched to its corresponding record in the PDD.

Step 5: Imputation of Missing or Invalid Data Values

Prior to running final risk models, it was necessary to impute missing or invalid data values so that all records could be retained in the model. When data were missing from the hospital submission, CCMRP replaced them with the lowest risk value for the variable in question. For example, if the hospital left the field *Diabetes* (Yes/No) blank, CCMRP assumed the condition was not present and assigned a "No" to that field. Likewise, if the value for the *NYHA congestive heart failure class* field was missing, we assigned the lowest risk category to this record—NYHA Class I.

The CCMRP policy decision to assign the lowest risk value to missing data was based on three factors: 1) many hospitals may leave data fields blank by design (e.g., blank means a co-morbid condition was not present or the value was normal); 2) consistency with the other major cardiac reporting programs, which replace missing data with the lowest risk or normal value; and 3) it creates an incentive for more complete coding by hospitals.[15]

In the case of the data element "creatinine," for example, the value was missing or recorded as "0" in approximately one-third of all cases submitted for analysis. In 1997, 1998, and 1999, the STS did not collect creatinine values unless those values exceeded 2.0. This coding practice made it impossible to distinguish between creatinine values below 2.0 (i.e., missing by design) and those that were truly missing (whether the value was below or above 2.0). Following the policy adopted for the 1997/1998 data collection, we assumed that all missing values of creatinine were "normal," and assigned them the value 1.0 mg/dl.

Between the 1997-98 and 1999 data collection periods, the percent of missing values decreased for most variables. In 1999, the variables with the largest number of missing values

[15] Note that in applying this policy, CCMRP replaced any missing values for the variable "coronary disease type" with the category found to be lowest risk in the All Quarters model: "double vessel disease." This rule differs from the one used for 1997-98 analysis in which missing values for this variable were replaced with the value "single vessel disease."

were: PTCA on same admission (N=8,513 or 38.3%), mitral insufficiency (N=7,835 or 35.2%), and left main stenosis (N=5,520 or 24.8%).

Hospitals with Unacceptable Quality Data

Not all hospitals responded to requests for data corrections and revisions with corrected data. Prior to producing the final risk-adjusted mortality results, staff and the Technical Advisory Panel had to decide whether data from any hospitals were so poor that their inclusion in the model would diminish overall predictive performance and lead to unreliable ratings for the hospitals in question. It was decided that data from two hospitals should be completely excluded from all analyses.

The internal data cleaning and external data validation processes used to generate this report appear to be more thorough than those used to produce similar statewide reports. CCMRP's efforts, however, were not exhaustive and have since been improved and expanded upon to ensure improved data integrity for reports in coming years.

Audit of 1999 Data

CCMRP developed and implemented an audit process designed to review the quality of the data submitted for 1999. Specifically, the 1999 data audit was designed to:

- Verify the accuracy of submitted data;
- Identify systematic coding problems that could compromise the validity of the statistical model;
- Determine if the rating received by a specific hospital was in any way a function of the hospital's coding practices. That is, did hospitals classified as better performers systematically overstate the severity of their cases (i.e., up-coding), or did hospitals classified as worse performers systematically understate the severity of their patient case-mix (i.e., down-coding); and,
- Determine the effect of CCMRP's policy to replace missing values with the lowest-risk category for each variable.

For 1999, 38 of 84 hospitals that originally submitted 1999 data were selected for audit, two of which refused audit and were dropped from the program. In total, 36 hospitals were audited, including all 16 hospitals that were identified in a preliminary analysis as either better or worse performers. An additional 20 hospitals were selected at random from the group of hospitals classified as "no different than expected."

Within each selected hospital, a subset of records was chosen for audit using a weighted random sample, in which all deaths were selected and records for more seriously ill patients were more likely to be selected. A total of 2,472 records, or 24% of all records submitted by the 36 targeted hospitals, were requested for audit. Overall, auditors were able to review 97.4% of requested records. The ***California Report on Coronary Artery Bypass Graft Surgery 1999 Data, Technical Appendix: Audit Summary 2003*** contains a detailed description of the audit process, analysis and findings. Summarized below are the analysis and key findings.

The audited data were compared against the data hospitals originally submitted to CCMRP. First, agreement statistics and bivariate frequencies were generated and analyzed in order to evaluate the accuracy of hospital coding for each variable. Second, a sensitivity analysis was

conducted to explore how hospital ratings would be affected if data submitted by the hospitals were replaced with the audit data.

The audit analysis found that most variables were coded acceptably, with the exception of *NYHA CHF Class*, *CCS Angina Class*, and *Acuity*. The poor coding of the *NYHA* and *CCS Class* variables had substantial implications for the validity of the model. Upon reviewing the audit findings, the CCMRP Technical Advisory Panel decided to exclude both *NYHA* and *CCS* class from the CCMRP model specifications. This decision had no effect on the fit of the final risk model or risk ratings of hospitals. The coding problems associated with *Acuity* were largely due to the subjective nature of coding this important variable. Hospitals identified as having severe coding problems with *Acuity* were asked to correct their data prior to the final analysis.

Other than the above-noted problems with *NYHA* and *CCS Class*, CCMRP did not find evidence of systematic coding problems among the hospitals classified as either "better" or "worse" than expected. However, hospitals rated "worse" than expected submitted, on average, more missing values in their data and tended to down-code (i.e., code as lower risk) more variables.

The decision to replace data originally submitted by the hospital with audit data led to several changes in hospital rankings (i.e., outlier status). The resulting changes were largely due to incorrect coding of the variables *Acuity* and *Discharge Status* (discussed earlier in this section). The audit data replacement strategy also resulted in significantly improved model performance.

All hospitals that were identified as outliers at the time the audit was conducted were audited. There were a few hospitals that submitted data after the audit commenced, one of which was identified as an outlier in the final analysis of the data; this single outlier hospital did not have its data audited because its data were received after the close of the audit.

IV. RISK MODEL AND RISK-ADJUSTED HOSPITAL MORTALITY RATES—1999

Patients treated at different hospitals may vary in the severity of their pre-operative clinical condition. To fairly compare outcomes at different hospitals, it is necessary to adjust for differences in the case mix of patients across hospitals. CCMRP "levels the playing field" by accounting for the pre-operative condition of each patient. Hospitals that routinely handle complex cases (i.e., sicker at the time of admission) get a larger risk-adjustment weighting in the risk model, while hospitals that handle less complex cases get a smaller weighting. CCMRP intentionally included as risk-adjustment variables only those data elements that describe the patient's condition prior to the heart bypass procedure.

Two sets of models and results are included in the report: 1) the **1999 Analysis** (full four quarters of 1999 data) and 2) the **All Quarters Analysis** (a roll-up of all continuous quarters of data submitted by hospitals for 1997 through 1999).[16] The discussion that follows starts with a presentation of the **1999 Analysis**, followed by the **All Quarters Analysis** and the analysis of the relationship between volume and outcome.

Risk Model Development—1999 Analysis

CCMRP used a multivariate logistic regression model to determine the relationship between each of the demographic and pre-operative risk variables and the likelihood of in-hospital mortality. Multivariate logistic regression models relate the probability of death to the explanatory factor, (e.g., patient age, the amount of creatinine in the blood, or the angina status of the patient) while controlling for all other explanatory factors in the model.

Table 4 presents the final model based on the 1999 dataset. Although the risk-adjustment model is based on data from 81 hospitals, a risk-adjusted score is reported for only 70 hospitals: two hospitals declined to participate in the audit, four hospitals declined to continue participation in the program subsequent to submitting their 1999 data (but prior to viewing any results), and five hospitals withdrew from the program after seeing their results (see Figure 2 in Section II). No unusual patterns of data coding or incompleteness were observed in these 11 hospitals, so their data were retained in the analysis to determine the risk-adjustment model, and this does not appear to bias the model in any way.

The entire dataset was divided randomly into two parts: a “training set” used to develop the model and a “test set” to assess fit. After a final model was chosen and tested, the coefficients were re-estimated using the entire dataset.

The first model tested included all variables that had been used in the 1997/98 CCMRP risk model. However, as described in the previous section, the audit uncovered substantial problems in the coding of the *NYHA CHF Class* and *CCS Angina Class* variables. As a consequence, these two variables were excluded from the final model with no loss of fit and no changes in the performance rankings of hospitals. It appeared that much of the information was already captured in the *CHF* (yes/no) variable.

[16] All hospitals included in either analysis submitted a minimum of four quarters of data from 1999.

The *Operative Incidence* variable was also modified somewhat in the current analysis. For the 1997/98 model, *Operative Incidence* was modeled with four categories (as opposed to three), the fourth category being "fourth or higher" operation. As none of the patients who experienced four or more operations died in 1999, the category was dropped because its coefficient was not estimable from the data.

Per the policy of CCMRP to encourage complete coding by hospitals and not to unfairly reward hospitals that engage in incomplete coding, missing values were replaced with the lowest risk value. *Age, Ejection Fraction,* and *Creatinine* were entered as continuous variables; the other variables were entered as ordered factors. For the variables entered as ordered factors, the coefficients should be compared to the reference category (for example, the coefficients for the acuity categories 'Urgent,' 'Emergent,' and 'Salvage' are compared to the Reference Group 'Elective').

The CCMRP approach to model selection reflects a decision to include both those factors identified by clinical experts as important predictors of CABG mortality and those that are statistically significant. Rather than focusing on parsimony, the CCMRP goal is to develop a clinically sound model that predicts well.

Table 4: Logistic Regression Risk Model, 1999 Analysis

Explanatory Factor		Coefficient	Standard Error	p-value	Significance	Odds Ratio
Intercept		-8.81	0.49	0.000	***	
Age (Years)		0.06	0.01	0.000	***	1.07
Gender	Female	Reference Group				
	Male ^	-0.45	0.09	0.000	***	0.64
Race	White ^*	Reference Group				
	Non-White	0.05	0.10	0.614		1.05
Creatinine (mg/dl)		0.19	0.05	0.000	***	1.21
Congestive Heart Failure	Present	0.54	0.10	0.000	***	1.72
Hypertension	Present	0.21	0.11	0.052		1.23
Dialysis	Yes	0.57	0.30	0.052		1.78
Diabetes	Present	0.20	0.09	0.029	*	1.23
Peripheral Vascular Disease	Present	0.20	0.11	0.071		1.22
Cerebrovascular Disease	Present	0.27	0.11	0.015	*	1.31
Ventricular Arrhythmia	Present	0.38	0.16	0.015	*	1.47
COPD	Present	0.33	0.11	0.003	**	1.40
Operative Incidence	First Operation ^	Reference Group				
	Second	0.82	0.13	0.000	***	2.26
	Third or Higher	1.25	0.30	0.000	***	3.50
Myocardial Infarction	None ^	Reference Group				
	Yes, but when unknown	-0.01	0.41	0.980		0.99
	21+ days ago	0.26	0.12	0.031	*	1.30
	7-20 days ago	0.57	0.17	0.001	**	1.77
	1-6 days ago	0.13	0.12	0.297		1.14
	Within 1 day	0.73	0.18	0.000	***	2.09
PTCA on this Admission	Yes	0.19	0.13	0.150		1.21
Angina	None	Reference Group				
	Stable ^	-0.37	0.16	0.027	*	0.69
	Unstable	0.06	0.14	0.663		1.06
Acuity	Elective ^	Reference Group				
	Urgent	0.32	0.11	0.004	**	1.38
	Emergent	1.38	0.15	0.000	***	3.96
	Salvage	3.14	0.28	0.000	***	23.12
Ejection Fraction (%)		-0.01	0.00	0.000	***	0.99
Left Main Stenosis (%)	50% or less^	Reference Group				
	51% to 70%	0.11	0.14	0.423		1.12
	71% to 90%	0.35	0.14	0.010	*	1.43
	91% or more	0.44	0.19	0.019	*	1.55
Number of Diseased Vessels	Single Vessel	Reference Group				
	Double Vessel ^	0.01	0.23	0.953		1.01
	Triple Vessel or More	0.15	0.21	0.496		1.16
	None (Left Main Stenosis only)	-0.72	0.76	0.346		0.49
Mitral Insufficiency	None ^	Reference Group				
	Trivial	0.05	0.18	0.792		1.05
	Mild	0.19	0.15	0.211		1.21
	Moderate	0.28	0.24	0.244		1.32
	Severe	0.20	0.55	0.720		1.22

Note: ^ refers to the specific category used to replace missing data for each variable.

Guide to Interpreting the Risk Model

Coefficient: The coefficient for each explanatory factor represents the effect that factor has on a patient's likelihood of dying (in the hospital) following bypass surgery. If the value is positive, it means that the characteristic is associated with an increased risk of death compared to not having the characteristic—while controlling for the effect of all of the other factors. If the coefficient is negative, having that characteristic is associated with a lower risk of death compared to not having it. The larger the value (whether positive or negative), the greater the effect or weight this characteristic has on the risk of dying. For example, note that the coefficient for "Congestive Heart Failure" in the 1999 model is 0.54 and statistically significant. This value is positive, so it indicates that CABG patients with congestive heart failure are at an increased risk of dying compared to patients that do not have the disease. On the other hand, the coefficient for the variable "Male" has a value of – 0.45. Since the value is negative, males have a lower probability of dying than females, after taking into account all other factors.

Standard Error: The standard error is the standard deviation of the sampling distribution of an estimate. It measures the statistical reliability of that estimate.

p–value: The p-value is a measure of the statistical significance of the coefficient compared to the reference category. Commonly, p-values of less than 0.05 are considered statistically significant. The smaller the p-value, the more likely the effect of a factor is real, rather than due to chance.

Significance: When the p-value of a coefficient is less than 0.05, it is deemed statistically significant at the 0.05 level and is denoted with one star (*) in the Significance column. Two stars (**) indicate statistical significance at the 0.01 level, and three stars (***) indicate statistical significance at the 0.001 level. All statistical tests are two-tailed tests.

Odds Ratio: An odds ratio is another way of characterizing the impact of each factor on in-hospital mortality. Mathematically, the odds ratio is the antilogarithm of the coefficient value. The larger the odds ratio, the greater the impact that characteristic has on the risk of dying. An odds ratio close to 1.0 means the effect of the factor is close to neutral. For example, the odds ratio for congestive heart failure (CHF) in the 1999 model is 1.72. This means that for patients with CHF, the odds of dying in-hospital are about 1.72 times higher compared to patients without CHF, assuming all other risk factors are the same. Males have an odds ratio of 0.64, which means that the odds that a man will die in-hospital after CABG surgery is about 0.64 times as high (i.e., about two thirds as much) as for a woman, assuming all other risk factors are the same.

Key Findings Regarding the Risk Model

- Although several of the variables do not appear to be "statistically significant" (as determined by the p-value), almost all coefficients appear with the expected sign from a clinical standpoint.

- *Age, Acuity* (i.e., urgency of the operation), *Ejection Fraction, Creatinine,* and *Operative Incidence* are the most important risk-model variables.

- Even after controlling for all other variables, *Gender* has a statistically significant effect, with males having about one-third lower mortality. There is some suggestion in the literature that *Gender* may be a proxy for body size.

- Experiencing *Myocardial Infarction* within 24 hours prior to CABG surgery more than doubles a patient's risk of in-hospital death.

- The degree of *Left Main Stenosis* significantly increases the risk of dying, particularly when 71% or greater.

- Of the comorbidities collected, *Congestive Heart Failure* has the largest effect.

Risk-Adjusted Mortality Rates–1999 Analysis

The logistic regression model in Table 4 was used to develop risk-adjusted mortality rates for each of the participating hospitals. Among hospitals participating in public reporting, 515 patients out of a total of 18,673 died in-hospital, reflecting an overall in-hospital death rate of 2.76%. This compares to an overall rate of 2.9% nationally for 1999 as reported by the Society of Thoracic Surgeons for 30-day operative mortality (see www.sts.org). Because some deaths occur after discharge but within 30 days, 30-day operative mortality is slightly higher than in-hospital mortality.

The **1999 Analysis** revealed that of the 70 hospital participants, three performed significantly "worse than expected" (i.e. their actual death rate was higher than what was expected/predicted), none performed "better than expected," and 67 performed "as expected." Because of the low mortality rate associated with bypass surgery (fewer than 3 deaths for every 100 cases in 1999), it is very difficult for hospitals to distinguish themselves as "better than expected" performers, which partly explains why there are no "better than expected" performers, but a number of "worse than expected" performers. This is especially true when only looking at a single year's worth of data, where confidence intervals can be quite wide for hospitals with low annual volumes of CABG cases. Given that California has many hospitals with small annual case volumes, this makes it more difficult to identify statistical outliers.

Table 5 and Figure 3 below present the risk-adjusted results for each of the 70 CCMRP participants in 1999. Table 5 displays the results alphabetically. Figure 3 shows the results graphically, sorted alphabetically within geographic region.

How to Read the Tables

***Number of CABG cases submitted*:** The number of isolated CABG cases the hospital submitted to CCMRP for full calendar year 1999.

***Number of observed deaths*:** The hospital's *actual* number of in-hospital deaths for isolated CABG patients in 1999. This number does not include patients who died after transfer or discharge from the facility.

***Number of expected deaths*:** CCMRP used the risk-adjustment model to calculate the probability of in-hospital death for each one of the cases included in the 1999 risk model. CCMRP staff then summed the probabilities for all cases at each hospital to calculate the number of in-hospital deaths expected at the hospital given its case mix. Example: Hospital X had 150 patients, 100 of whom had a 1% probability of death, 40 of whom had a 4% probability of death, and 10 with a 9% probability of death, the total number of expected deaths would be 3.5 (i.e., (100)(1%) + (40)(4%) + (10)(9%) = 1 + 1.6 + 0.9 = 3.5 expected deaths). Note that the number of expected deaths can be a fractional number, unlike the number of observed deaths—which can only be a whole number.

O/E ratio*: *The observed to expected mortality ratio: The O/E ratio is the number of observed deaths (numerator), divided by the number of expected deaths (denominator) as predicted from the risk-adjustment model. Example, if the observed number of deaths was 18 and the predicted number of deaths was 21.36, then the O/E ratio would be 18/21.36=0.84. An O/E ratio greater than 1.0 means that the hospital had more deaths than would have been expected given the case-mix of its patients. An O/E ratio lower than 1.0 means that the hospital had fewer deaths than would have been expected given the case-mix of its patients. Small differences in the O/E ratio are usually not significant. The performance rating a hospital receives is not based on the O/E ratio, but instead on whether the actual death rate falls within the 95% confidence range of the "expected death rate." Thus, hospitals that have O/E ratios of less than or greater than one are not classified as "better than" or "worse than" expected unless the result has also been found to be statistically significant.

***Observed death rate*:** This is the actual death rate for the hospital. It is calculated by dividing the number of observed deaths (numerator) for the hospital by the total number of cases for the hospital (denominator). For example, if the hospital had 250 isolated CABG cases, with seven actual in-hospital deaths, the observed death rate would be 7/250 = 2.8%.

***Expected death rate*:** The number of "expected" or predicted deaths from the risk model (numerator) is divided by the number of cases (denominator) to derive the expected death rate. If the hospital had 250 isolated CABG cases and an expected number of in-hospital deaths of 8.2, the *expected death rate* would be 8.2/250 = 3.28%. Note that the expected death rate is a measure of the average severity of illness of each hospital's isolated CABG patients: the higher the expected rate, the higher the average severity. The average death rate for the entire 1999 dataset is 2.83%[17], so if a hospital's expected death rate is higher than 2.83%, the hospital's isolated CABG patients tend to be higher risk than the overall population of CABG patients in CCMRP's dataset.

***Lower and upper confidence intervals on the expected death rate*:** Confidence intervals provide a measure of the confidence regarding the estimate of the "expected" death rate. A lower confidence limit bound on the expected rate is computed by subtracting twice the standard deviation from the expected rate. Similarly, the upper bound is calculated by adding twice the standard deviation to the expected rate. Two standard deviations (2SD) below and above the expected rate is an approximate 95% confidence interval. The range that is bounded by the upper and lower intervals can be interpreted as 95 out of 100 times, the "true expected death rate" would fall within that range. Smaller intervals mean that we have more confidence in our estimate. The width of the confidence interval depends both on the number of cases that

[17] The 1999 risk model is based on data from 81 hospitals that submitted data to CCMRP for 1999; although only 70 hospitals ultimately agreed to public reporting. The death rate of 2.83% is that for the complete set of data included in the 1999 risk model—21,973 cases from the 81 hospitals that submitted data.

a hospital submitted, and the variability of the difference in the risks for the hospital's isolated CABG patients. A hospital with a larger number of cases will have a narrower confidence interval than a hospital with fewer cases. Because there is a great deal of variability in patient risks, the CCMRP model calculates the standard deviation based on the predictions of risk for each patient rather than using the average risk over all patients at each hospital.

***Overall performance rating*:** The hospital's overall performance rating is based on a comparison of each facility's *observed death rate* to the 95% confidence interval around the hospital's *expected death rate*. This is a test of statistical significance. Effectively, hospitals are only classified as "better" or "worse" than expected if their *observed mortality rate* falls outside the 95% confidence interval of the *expected death rate*. CCMRP splits all hospitals into one of three groups:

- **Worse than expected**—the observed death rate is higher than the upper bound of the 95% confidence interval of the expected death rate.
- **Better than expected**—the observed death rate is lower than the lower bound of the 95% confidence interval of the expected death rate.
- **No different than expected**—the observed death rate falls within the 95% confidence interval of the expected death rate.

Table 5: Risk-Adjusted Results for CCMRP Hospitals, 1999, Sorted Alphabetically

Hospital Name	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	O/E Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
Alta Bates Medical Center	96	4	2.62	1.53	4.17	0.00	2.73	5.84	No Different
Alvarado Hospital Medical Center	148	6	6.01	1.00	4.05	1.04	4.06	7.08	No Different
CA Pacific Medical Center-Pacific Campus	172	4	6.00	0.67	2.33	0.98	3.49	6.00	No Different
Cedars-Sinai Medical Center	352	9	11.05	0.81	2.56	1.43	3.14	4.85	No Different
Community Mem. Hosp. of San Buenaventura	188	4	3.87	1.03	2.13	0.08	2.06	4.04	No Different
Dameron Hospital	109	6	4.39	1.37	5.50	0.66	4.03	7.40	No Different
Daniel Freeman Memorial Hospital	156	6	4.11	1.46	3.85	0.24	2.64	5.03	No Different
Desert Regional Medical Center	133	9	3.81	2.36	6.77	0.15	2.86	5.57	Worse Than Expected
Doctor's Medical Center - Modesto	508	12	9.53	1.26	2.36	0.74	1.88	3.01	No Different
Doctor's Medical Center - San Pablo	81	0	2.29	0.00	0.00	0.00	2.82	6.30	No Different
Dominican Hospital	160	4	4.24	0.94	2.50	0.30	2.65	5.00	No Different
El Camino Hospital	108	3	4.55	0.66	2.78	1.10	4.22	7.34	No Different
Encino Tarzana Regional Medical Center	172	7	6.75	1.04	4.07	1.16	3.92	6.69	No Different
Glendale Adventist Med Ctr - Wilson Terrace	267	11	7.02	1.57	4.12	0.79	2.63	4.47	No Different
Glendale Memorial Hospital and Health Center	178	7	7.26	0.96	3.93	1.34	4.08	6.82	No Different
Granada Hills Community Hospital	72	2	1.72	1.16	2.78	0.00	2.40	5.85	No Different
Green Hospital of Scripps Clinic	229	4	2.93	1.36	1.75	0.00	1.28	2.71	No Different
Heart Hospital of the Desert	87	0	2.83	0.00	0.00	0.00	3.25	6.79	No Different
Hoag Memorial Hospital Presbyterian	255	9	11.11	0.81	3.53	2.04	4.36	6.68	No Different
John Muir Medical Center	126	6	6.76	0.89	4.76	1.79	5.36	8.93	No Different

Table 5: Risk-Adjusted Results for CCMRP Hospitals, 1999, Sorted Alphabetically

Hospital Name	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
Kaiser Foundation Hospital - Los Angeles	1597	23	26.83	0.86	1.44	1.07	1.68	2.29	No Different
Kaiser Foundation Hospital - San Francisco	1282	23	22.50	1.02	1.79	1.07	1.75	2.44	No Different
Kaweah Delta Hospital	402	10	12.99	0.77	2.49	1.57	3.23	4.89	No Different
Loma Linda University Medical Center	402	6	11.94	0.50	1.49	1.38	2.97	4.56	No Different
Long Beach Memorial Medical Center	363	13	12.57	1.03	3.58	1.66	3.46	5.26	No Different
Marin General Hospital	67	4	1.65	2.42	5.97	0.00	2.47	5.82	Worse Than Expected
Memorial Medical Center of Modesto	299	10	6.18	1.62	3.34	0.48	2.07	3.66	No Different
Mercy Medical Center - Redding	216	8	8.17	0.98	3.70	1.39	3.78	6.17	No Different
Methodist Hospital of Southern California	282	4	6.19	0.65	1.42	0.54	2.20	3.85	No Different
Mission Hospital and Regional Medical Center	237	6	4.60	1.30	2.53	0.22	1.94	3.66	No Different
Palomar Medical Center	115	5	3.39	1.47	4.35	0.00	2.95	5.99	No Different
Presbyterian Intercommunity Hospital	73	1	1.47	0.68	1.37	0.00	2.01	5.20	No Different
Providence Holy Cross Medical Center	106	2	3.69	0.54	1.89	0.34	3.48	6.63	No Different
Providence St. Joseph Medical Center	192	4	4.69	0.85	2.08	0.32	2.44	4.57	No Different
Redding Medical Center	518	6	9.53	0.63	1.16	0.70	1.84	2.98	No Different
Saddleback Memorial Medical Center	132	8	4.76	1.68	6.06	0.50	3.60	6.71	No Different
Salinas Valley Memorial Hospital	323	8	8.97	0.89	2.48	1.04	2.78	4.52	No Different
San Antonio Community Hospital	120	3	5.57	0.54	2.50	1.12	4.64	8.16	No Different
San Jose Medical Center	66	2	1.71	1.17	3.03	0.00	2.59	6.14	No Different
Santa Barbara Cottage Hospital	272	6	7.40	0.81	2.21	0.87	2.72	4.57	No Different
Santa Monica - UCLA Hospital Med Ctr	58	2	3.72	0.54	3.45	0.64	6.41	12.18	No Different

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Table 5: Risk-Adjusted Results for CCMRP Hospitals, 1999, Sorted Alphabetically

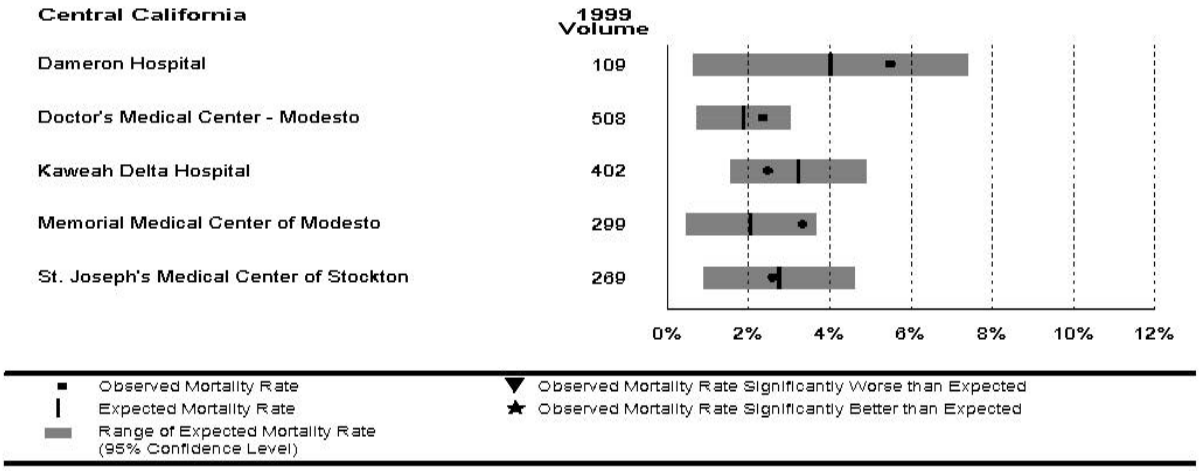
Hospital Name	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	O/E Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
Santa Rosa Memorial Hospital	187	9	9.10	0.99	4.81	2.05	4.87	7.69	No Different
Scripps Memorial Hospital - La Jolla	424	11	14.64	0.75	2.59	1.78	3.45	5.12	No Different
Scripps Mercy	256	16	8.96	1.79	6.25	1.35	3.50	5.64	Worse Than Expected
Sequoia Hospital	234	7	8.51	0.82	2.99	1.38	3.64	5.89	No Different
Seton Medical Center-Heart Institute	481	12	10.49	1.14	2.49	0.91	2.18	3.45	No Different
Sharp Chula Vista Medical Center	290	6	9.41	0.64	2.07	1.27	3.24	5.22	No Different
Sharp Grossmont Hospital	148	3	3.48	0.86	2.03	0.00	2.35	4.76	No Different
Sharp Memorial Hospital	251	12	7.09	1.69	4.78	0.87	2.82	4.78	No Different*
St. Bernardine Medical Center	557	14	15.65	0.89	2.51	1.48	2.81	4.14	No Different
St. Francis Medical Center	96	1	3.32	0.30	1.04	0.00	3.45	6.98	No Different
St. Helena Hospital	261	10	9.76	1.02	3.83	1.56	3.74	5.92	No Different
St. John's Hospital & Health Ctr - Santa Monica	148	6	5.56	1.08	4.05	1.01	3.76	6.51	No Different
St. Joseph Hospital - Orange	313	4	8.13	0.49	1.28	0.92	2.60	4.27	No Different
St. Joseph's Medical Center of Stockton	269	7	7.43	0.94	2.60	0.91	2.76	4.61	No Different
St. Jude Medical Center	293	10	7.30	1.37	3.41	0.85	2.49	4.13	No Different
St. Mary's Hospital and Medical Center - SF	553	10	16.77	0.60	1.81	1.65	3.03	4.41	No Different
St. Vincent Medical Center	282	9	8.17	1.10	3.19	1.02	2.90	4.78	No Different
Stanford University Hospital	221	7	6.99	1.00	3.17	0.94	3.16	5.38	No Different
Summit Medical Center	197	7	9.61	0.73	3.55	2.37	4.88	7.39	No Different
Sutter Memorial Hospital	623	12	19.10	0.63	1.93	1.76	3.07	4.37	No Different
The Hosp of the Good Samaritan - Los Angeles	649	25	26.58	0.94	3.85	2.65	4.10	5.55	No Different

Table 5: Risk-Adjusted Results for CCMRP Hospitals, 1999, Sorted Alphabetically

Hospital Name	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	O/E Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
Torrance Memorial Medical Center	202	7	5.60	1.25	3.47	0.65	2.77	4.89	No Different
Tri-City Medical Center	196	4	5.11	0.78	2.04	0.54	2.61	4.67	No Different
UC Irvine Medical Center	70	3	2.05	1.46	4.29	0.00	2.93	6.69	No Different
UCD Medical Center	169	4	4.21	0.95	2.37	0.26	2.49	4.73	No Different
UCLA Medical Center	177	8	6.24	1.28	4.52	1.04	3.53	6.02	No Different
UCSF Medical Center	134	5	3.06	1.63	3.73	0.00	2.28	4.67	No Different
USC University Hospital	105	6	3.12	1.93	5.71	0.00	2.97	6.13	No Different
Washington Hospital - Fremont	168	13	10.51	1.24	7.74	3.09	6.25	9.42	No Different

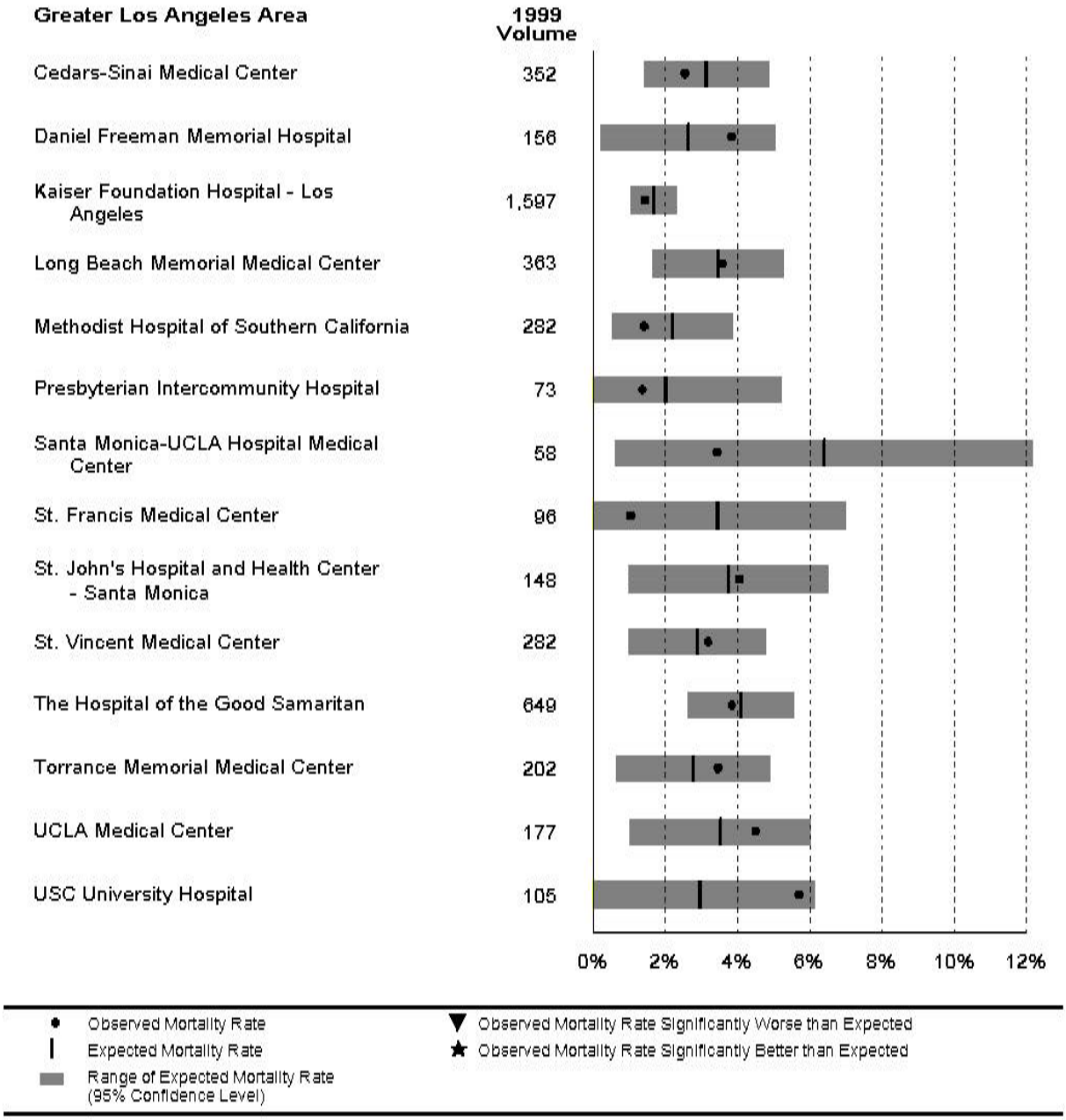
Note: *Sharp Memorial Hospital had an observed death rate of 4.781 and the upper 95% CI of the expected death rate was 4.778.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(in Alphabetical Order by Geographical Region)



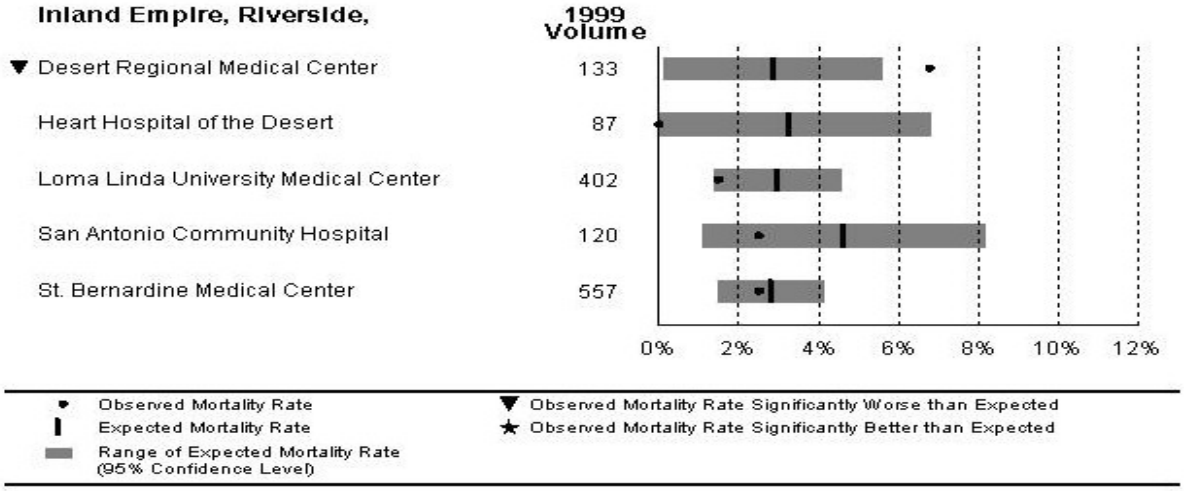
NOTE: The following hospitals in this region declined to participate:
Bakersfield Memorial Hospital, Fresno Community Hospital and Medical Center, Marian Medical Center, San Joaquin Community Hospital, St. Agnes Medical Center.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



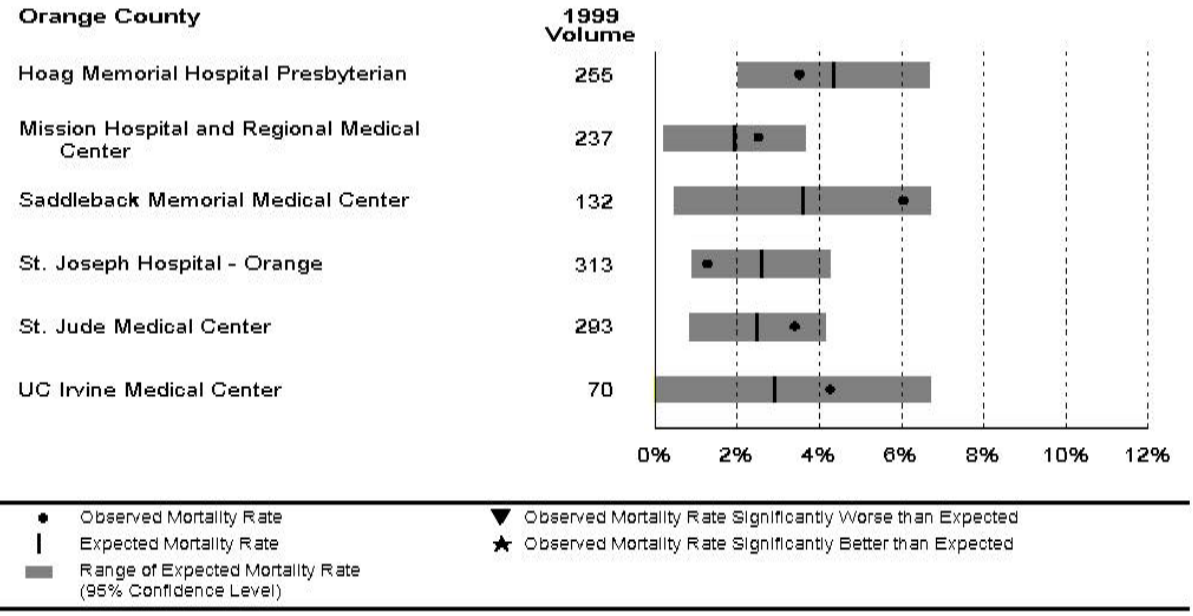
NOTE: The following hospitals in this region declined to participate:
Beverly Hospital, Brotman Medical Center, Centinela Hospital Medical Center, Downey Community Hospital, Garfield Medical Center, Huntington Memorial Hospital, Intercommunity/Citrus Valley Medical Center, LA County, Harbor-UCLA Medical Center, LA County/USC Medical Center, Lakewood Regional Medical Center, Little Company of Mary, St. Mary's Medical Center - Long Beach, White Memorial Medical Center.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



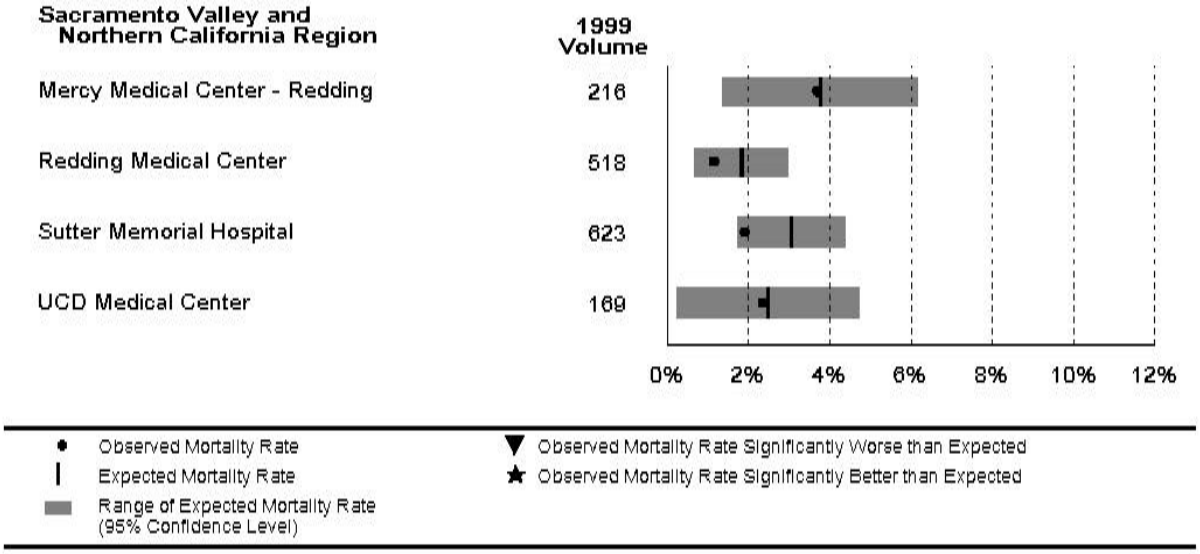
NOTE: The following hospitals in this region declined to participate:
Eisenhower Medical Center, Pomona Valley Hospital and Medical Center,
Riverside Community Medical Center, St. Mary's Regional Medical Center.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



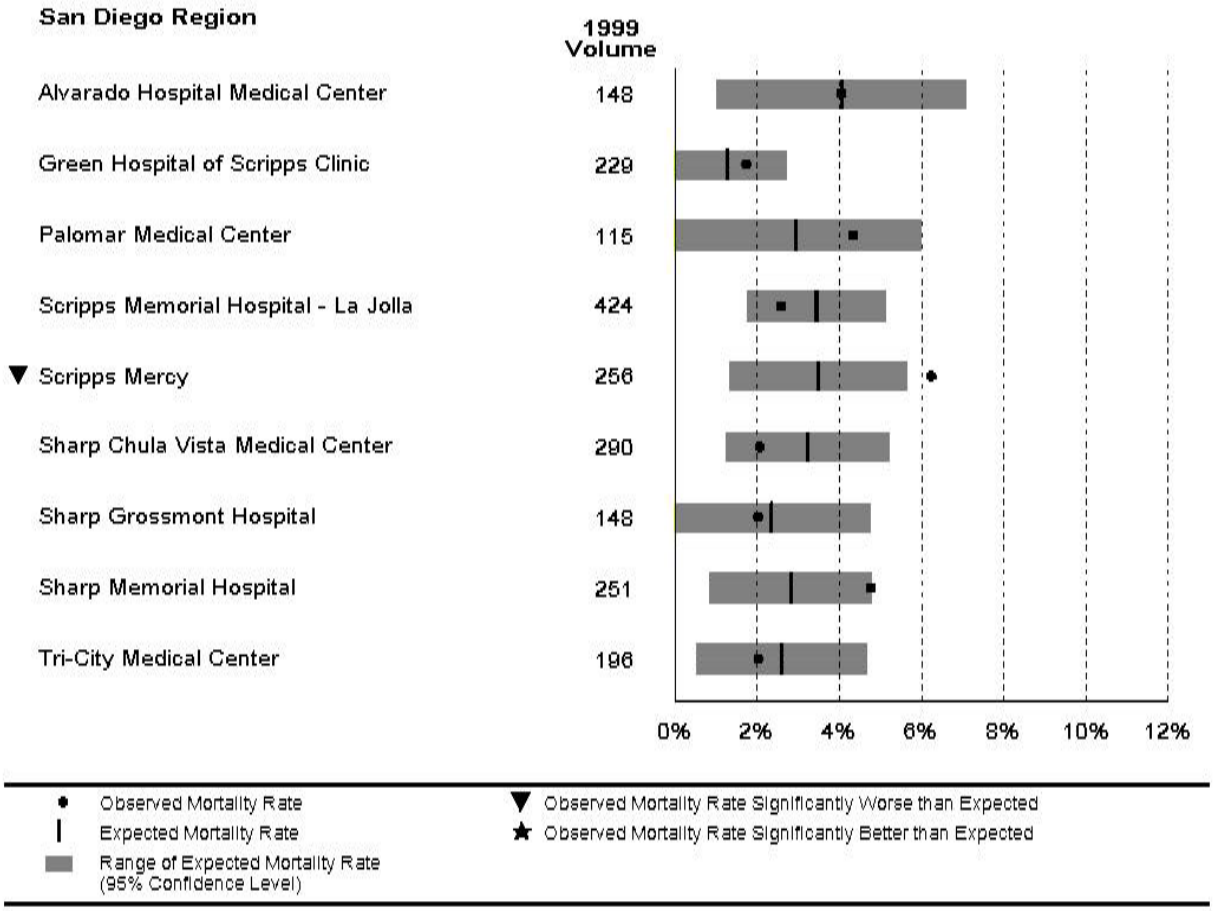
NOTE: The following hospitals in this region declined to participate:
Anaheim Memorial Medical Center, Fountain Valley Regional Hospital, West Anaheim Medical Center, Western Medical Center - Anaheim, Western Medical Center - Santa Ana.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



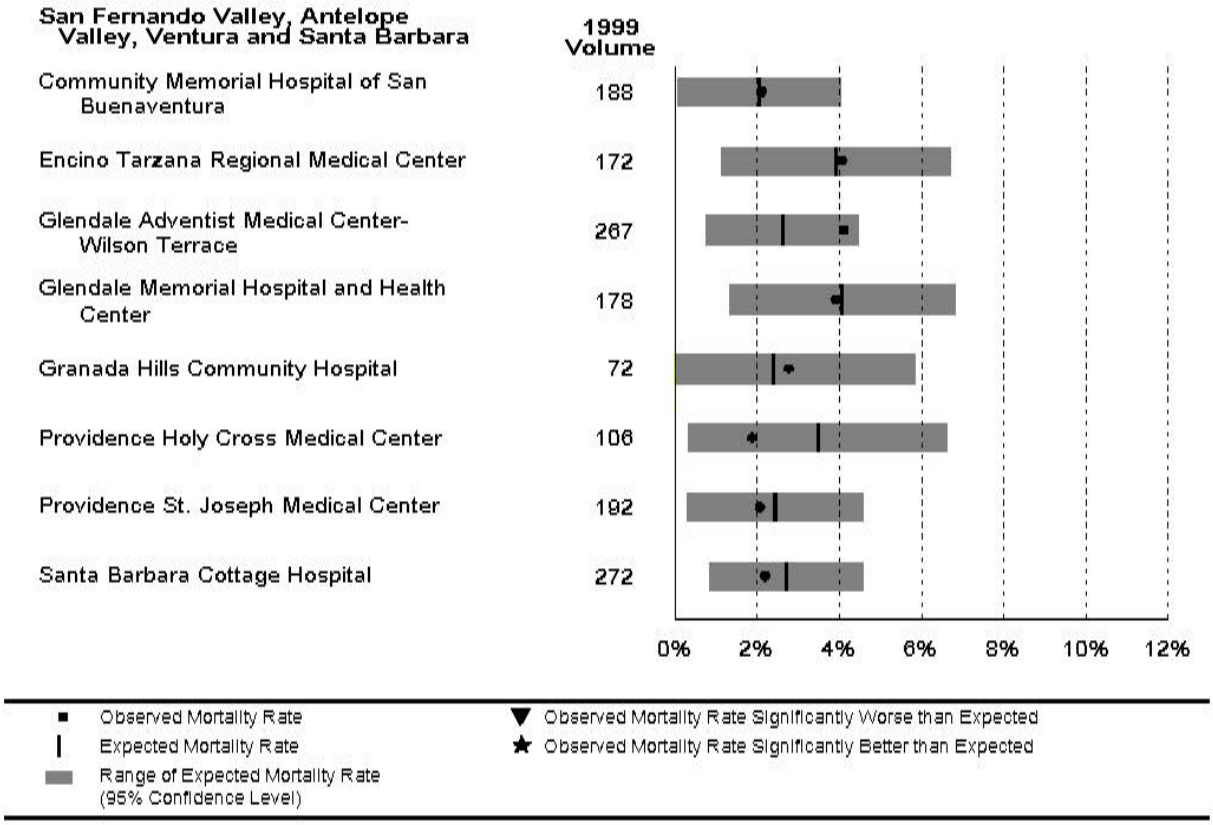
NOTE: The following hospitals in this region declined to participate:
Enloe Medical Center, Mercy General Hospital, Mercy San Juan Hospital.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



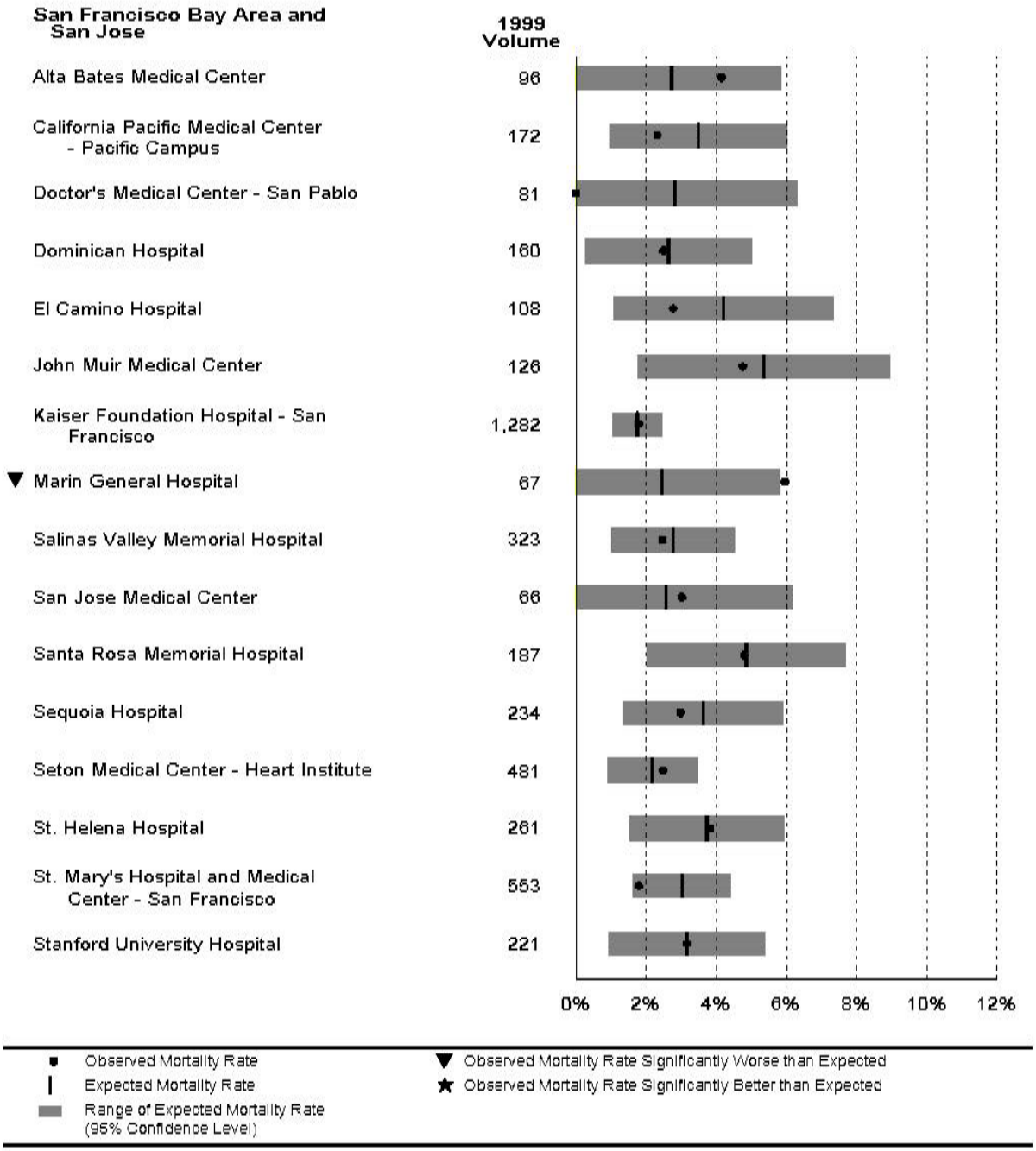
NOTE: The following hospitals in this region declined to participate:
UCSD Medical Center - Hillcrest, UCSD Medical Center - Thornton.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



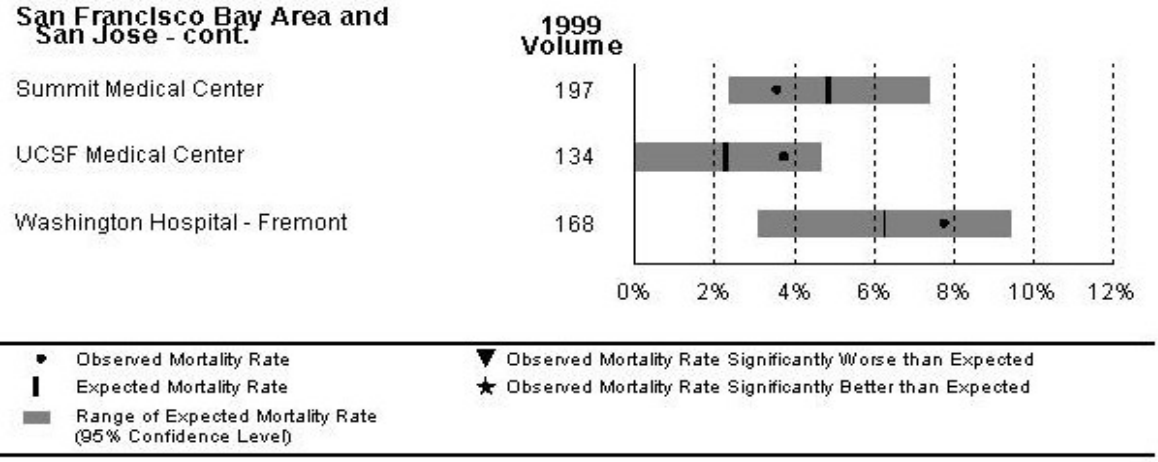
NOTE: The following hospitals in this region declined to participate:
Antelope Valley Hospital Medical Center, French Hospital - San Luis Obispo,
Lancaster Community Hospital, Los Robles Regional Medical Center,
Northridge Hospital Medical Center, St. John's Regional Medical Center - Oxnard,
Valley Presbyterian Hospital, West Hills Regional Medical Center.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



NOTE: The following hospitals in this region declined to participate:
Good Samaritan Hospital - San Jose, Mt. Diablo Medical Center, O'Conner Hospital, Queen of the Valley Hospital, Santa Clara Valley Medical Center, Mills-Peninsula Hospital.

Figure 3: Comparison of Observed to Expected Mortality Rate, 1999
(cont.) (in Alphabetical Order by Geographical Region)



NOTE: The following hospitals in this region declined to participate:
Good Samaritan Hospital - San Jose, Mt. Diablo Medical Center, O'Conner Hospital, Queen of the Valley Hospital, Santa Clara Valley Medical Center, Mills-Peninsula Hospital.

V. RISK MODEL AND RISK-ADJUSTED HOSPITAL MORTALITY RATES—ALL QUARTERS DATA (1997-1999)

The **All Quarters** dataset represents a roll-up of all continuous quarters of data submitted by CCMRP participating hospitals for 1997 through 1999. Because it is based on more than one year's mortality outcomes for the majority of hospitals, the **All Quarters Analysis** should allow for improved precision in evaluating each hospital's "true" performance. This can be useful in assessing outcomes for relatively low volume hospitals, whose mortality experience tends to be more variable year-to-year (i.e., in making estimates from any period of data, the confidence intervals widen as the number of cases decreases).

As in the **1999 Analysis**, the **All Quarters** risk model is based on data submitted by 81 hospitals; although risk-adjusted results are presented only for the 70 hospitals that ultimately decided to publicly report their data. Like the **1999 Analysis**, all hospitals included in the **All Quarters Analysis** submitted a minimum of four quarters of data from 1999. Among the 81 hospitals included in the **All Quarters** risk model, 68 also submitted data from quarters prior to 1999. Among the 70 hospitals that are publicly reporting their results, 58 submitted more than four quarters worth of data.

Risk Model Development—All Quarters Analysis

The procedures and variables used to develop the **All Quarters** risk-adjustment model are exactly the same as those described for the **1999 Analysis**. The coefficients and odds ratios differ slightly from the 1999 risk model, as the **All Quarters** model is based on a larger number of cases (Table 6). Some of the coefficients of the variables that were not statistically significant in the **1999 Analysis** model become significant in the **All Quarters** model given the larger number of cases, which increases the power to detect differences. See the preceding section for a guide to interpreting the risk model.

Table 6: Logistic Regression Risk Model, All Quarters (1997-1999)

Explanatory Factor		Coefficient	Standard Error	p-value	Significance	Odds Ratio
Intercept		-7.95	0.33	0.000	***	
Age (Years)		0.05	0.00	0.000	***	1.05
Gender	Female	Reference Group				
	Male ^	-0.43	0.06	0.000	***	0.65
Race	White ^	Reference Group				
	Non-White	0.14	0.07	0.055		1.15
Creatinine (mg/dl)		0.21	0.03	0.000	***	1.23
Congestive Heart Failure	Present	0.52	0.07	0.000	***	1.68
Hypertension	Present	0.15	0.07	0.030	*	1.17
Dialysis	Yes	0.24	0.21	0.261		1.27
Diabetes	Present	0.12	0.06	0.069		1.12
Peripheral Vascular Disease	Present	0.32	0.07	0.000	***	1.38
Cerebrovascular Disease	Present	0.28	0.08	0.000	***	1.32
Ventricular Arrhythmia	Present	0.37	0.10	0.000	***	1.45
COPD	Present	0.31	0.07	0.000	***	1.36
Operative Incidence	First Operation ^	Reference Group				
	Second Operation	0.77	0.09	0.000	***	2.16
	Third or Higher	1.39	0.20	0.000	***	4.03
Myocardial Infarction	None ^	Reference Group				
	Yes, but when unknown	0.18	0.18	0.308		1.20
	21+ days ago	0.13	0.08	0.102		1.14
	7-20 days ago	0.26	0.13	0.040	*	1.30
	1-6 days ago	0.19	0.08	0.021	*	1.22
	Within 1 day	0.84	0.12	0.000	***	2.33
PTCA on this Admission	Yes	0.32	0.07	0.000	***	1.37
Angina	None	Reference Group				
	Stable ^	-0.26	0.11	0.017	*	0.77
	Unstable	-0.05	0.10	0.641		0.96
Acuity	Elective ^	Reference Group				
	Urgent	0.32	0.07	0.000	***	1.37
	Emergent	1.12	0.10	0.000	***	3.08
	Salvage	3.17	0.18	0.000	***	23.88
Ejection Fraction (%)		-0.01	0.00	0.000	***	0.99
Left Main Stenosis (%)	50% or less ^	Reference Group				
	51% to 70%	0.04	0.10	0.678		1.04
	71% to 90%	0.34	0.10	0.001	**	1.40
	91% or more	0.46	0.13	0.000	***	1.58
Number of Diseased Vessels	Single Vessel	Reference Group				
	Double Vessel ^	0.13	0.17	0.427		1.14
	Triple Vessel or more	0.36	0.15	0.020	*	1.43
	None (Left Main Stenosis only)	0.47	0.34	0.167		1.60
Mitral Insufficiency	None ^	Reference Group				
	Trivial	0.26	0.12	0.029	*	1.30
	Mild	0.27	0.11	0.013	*	1.31
	Moderate	0.46	0.15	0.003	**	1.59
	Severe	0.70	0.32	0.028	*	2.02

Note: ^ refers to the specific category used to replace missing data for each variable.

All Quarters Risk-Adjusted Rates

The **All Quarters** logistic regression model in Table 6 was used to develop risk-adjusted mortality results for the 70 hospitals that submitted continuous quarters of data between 1997 and 1999 and chose to publicly report their results. The number of quarters varies across hospitals, with a minimum of four (all of 1999) to a maximum of twelve (1997, 1998, and 1999). This variation is a function of when hospitals joined CCMRP and began submitting data on a continuous basis. Among the 70 hospitals, twelve began participation in 1999. As such, their All Quarters result will be virtually identical to their 1999 result. These twelve hospitals are noted with an asterisk in the tables below.

Among the 70 hospitals participating in public reporting, the **All Quarters** data includes a total of 1,048 in-hospital deaths out of 40,265 cases, reflecting an overall in-hospital death rate of 2.60%. This can be compared to a death rate of 2.20% in New York State for the 1997-1999 period (2002).

Key findings from the **All Quarters** analysis are:

- Given the larger number of cases for most hospitals, compared to the single year analysis, we are able to discern each hospital's performance with greater precision (i.e., the width of the confidence interval narrows around each hospital's estimate).

- Five hospitals performed significantly better than expected (Doctor's Medical Center-San Pablo, Heart Hospital of the Desert, Scripps Memorial Hospital-La Jolla, Summit Medical Center, and Sutter Memorial Hospital).

- Six of the 70 hospitals performed significantly worse than expected (Alta Bates Medical Center, Desert Regional Medical Center, Marin General Hospital, Memorial Medical Center of Modesto, Presbyterian Intercommunity Hospital, and Scripps Mercy).

- Fifty-nine of the hospitals performed no different than expected.

- A statistically significant relationship was found between the volume of cases and mortality outcomes.

Table 7 (sorted alphabetically) and Figure 4 (sorted alphabetically within region) display the performance results for each hospital. A guide to interpreting the tables can be found in the previous section. An additional column has been added to the **All Quarters** Results Tables and Figures: 1) ***Participation Period*** presents the number of quarters for which each hospital submitted data between 1997 and 1999. In addition, Figure 4 includes additional information regarding ***Annualized Volume***—the average annual volume of isolated CABG cases for each hospital.

Table 7: Risk-Adjusted Results for CCMRP Hospitals, All Quarters (1997-1999), Sorted Alphabetically

Hospital Name	Participation Period	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	O/E Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
Alta Bates Medical Center	Y97Q1-Y99Q4	372	15	8.66	1.73	4.03	0.88	2.33	3.78	Worse Than Expected
Alvarado Hospital Medical Center	Y97Q1-Y99Q4	445	22	16.72	1.32	4.94	2.06	3.76	5.45	No Different
CA Pacific Medical Center - Pacific Campus	Y98Q1-Y99Q4	348	10	10.13	0.99	2.87	1.24	2.91	4.58	No Different
Cedars-Sinai Medical Center	Y97Q1-Y99Q4	1220	28	33.59	0.83	2.30	1.88	2.75	3.63	No Different
Community Mem. Hosp. of San Buenaventura	Y98Q1-Y99Q4	390	8	6.59	1.21	2.05	0.43	1.69	2.95	No Different
Dameron Hospital	Y98Q1-Y99Q4	216	9	7.53	1.19	4.17	1.22	3.49	5.76	No Different
Daniel Freeman Memorial Hospital	Y98Q1-Y99Q4	329	8	9.15	0.87	2.43	1.07	2.78	4.49	No Different
Desert Regional Medical Center	Y98Q1-Y99Q4	255	14	5.93	2.36	5.49	0.52	2.32	4.13	Worse Than Expected
Doctor's Medical Center - Modesto	Y98Q1-Y99Q4	959	23	15.54	1.48	2.40	0.84	1.62	2.40	No Different
Doctor's Medical Center - San Pablo	Y97Q1-Y99Q4	250	3	9.73	0.31	1.20	1.66	3.89	6.12	Better Than Expected
Dominican Hospital	Y97Q1-Y99Q4	432	14	12.51	1.12	3.24	1.42	2.90	4.37	No Different
El Camino Hospital	Y98Q3-Y99Q4	157	4	6.38	0.63	2.55	1.54	4.07	6.59	No Different
Encino Tarzana Regional Medical Center	Y98Q1-Y99Q4	317	9	12.30	0.73	2.84	1.82	3.88	5.94	No Different
Glendale Adventist Med Ctr- Wilson Terrace	Y98Q4-Y99Q4	324	13	8.39	1.55	4.01	0.91	2.59	4.27	No Different
Glendale Memorial Hospital and Health Center	Y98Q1-Y99Q4	401	15	15.41	0.97	3.74	2.06	3.84	5.63	No Different
Granada Hills Community Hospital	Y97Q1-Y99Q4	213	6	3.97	1.51	2.82	0.06	1.86	3.66	No Different
Green Hospital of Scripps Clinic*	Y99Q1-Y99Q4	229	4	3.07	1.30	1.75	0.00	1.34	2.81	No Different
Heart Hospital of the Desert	Y97Q4-Y99Q4	218	1	6.49	0.15	0.46	0.81	2.98	5.15	Better Than Expected
Hoag Memorial Hospital Presbyterian	Y97Q1-Y99Q4	751	18	27.39	0.66	2.40	2.40	3.65	4.90	No Different
John Muir Medical Center	Y98Q1-Y99Q4	254	15	10.19	1.47	5.91	1.77	4.01	6.26	No Different
Kaiser Foundation Hospital - Los Angeles	Y97Q1-Y99Q4	3899	56	68.88	0.81	1.44	1.36	1.77	2.17	No Different

Table 7: Risk-Adjusted Results for CCMRP Hospitals, All Quarters (1997-1999), Sorted Alphabetically

Hospital Name	Participation Period	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	O/E Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
Kaiser Foundation Hospital - San Francisco	Y98Q1-Y99Q4	2274	44	40.05	1.10	1.93	1.25	1.76	2.28	No Different
Kaweah Delta Hospital	Y97Q1-Y99Q4	964	19	27.17	0.70	1.97	1.83	2.82	3.81	No Different
Loma Linda University Medical Center*	Y99Q1-Y99Q4	402	6	11.58	0.52	1.49	1.31	2.88	4.45	No Different
Long Beach Memorial Medical Center	Y98Q1-Y99Q4	741	20	22.44	0.89	2.70	1.84	3.03	4.22	No Different
Marin General Hospital*	Y99Q1-Y99Q4	67	4	1.65	2.43	5.97	0.00	2.46	5.78	Worse Than Expected
Memorial Medical Center of Modesto	Y97Q1-Y99Q4	849	26	14.69	1.77	3.06	0.86	1.73	2.60	Worse Than Expected
Mercy Medical Center-Redding	Y98Q3-Y99Q4	328	11	12.00	0.92	3.35	1.74	3.66	5.58	No Different
Methodist Hospital of Southern California	Y97Q1-Y99Q4	710	21	16.18	1.30	2.96	1.21	2.28	3.35	No Different
Mission Hospital and Regional Medical Center*	Y99Q1-Y99Q4	237	6	4.62	1.30	2.53	0.22	1.95	3.67	No Different
Palomar Medical Center	Y97Q1-Y99Q4	464	17	12.39	1.37	3.66	1.26	2.67	4.08	No Different
Presbyterian Intercommunity Hospital	Y98Q1-Y99Q4	190	10	4.84	2.07	5.26	0.46	2.55	4.63	Worse Than Expected
Providence Holy Cross Medical Center*	Y99Q1-Y99Q4	106	2	3.73	0.54	1.89	0.34	3.51	6.69	No Different
Providence St. Joseph Medical Center*	Y99Q1-Y99Q4	192	4	4.80	0.83	2.08	0.35	2.50	4.65	No Different
Redding Medical Center	Y97Q1-Y99Q4	1555	20	27.90	0.72	1.29	1.15	1.79	2.44	No Different
Saddleback Memorial Medical Center	Y98Q1-Y99Q4	307	17	10.88	1.56	5.54	1.53	3.54	5.55	No Different
Salinas Valley Memorial Hospital	Y98Q3-Y99Q4	458	10	13.66	0.73	2.18	1.47	2.98	4.49	No Different
San Antonio Community Hospital	Y98Q1-Y99Q4	243	6	11.97	0.50	2.47	2.44	4.93	7.42	No Different
San Jose Medical Center*	Y99Q1-Y99Q4	66	2	1.61	1.24	3.03	0.00	2.44	5.95	No Different
Santa Barbara Cottage Hospital	Y98Q1-Y99Q4	533	15	11.80	1.27	2.81	1.00	2.21	3.42	No Different
Santa Monica - UCLA Hospital Med Ctr	Y98Q1-Y99Q4	103	4	5.07	0.79	3.88	1.00	4.92	8.84	No Different
Santa Rosa Memorial Hospital*	Y99Q1-Y99Q4	187	9	8.98	1.00	4.81	2.05	4.80	7.55	No Different
Scripps Memorial Hospital - La Jolla	Y97Q1-Y99Q4	1098	26	37.73	0.69	2.37	2.43	3.44	4.45	Better Than Expected

Table 7: Risk-Adjusted Results for CCMRP Hospitals, All Quarters (1997-1999), Sorted Alphabetically

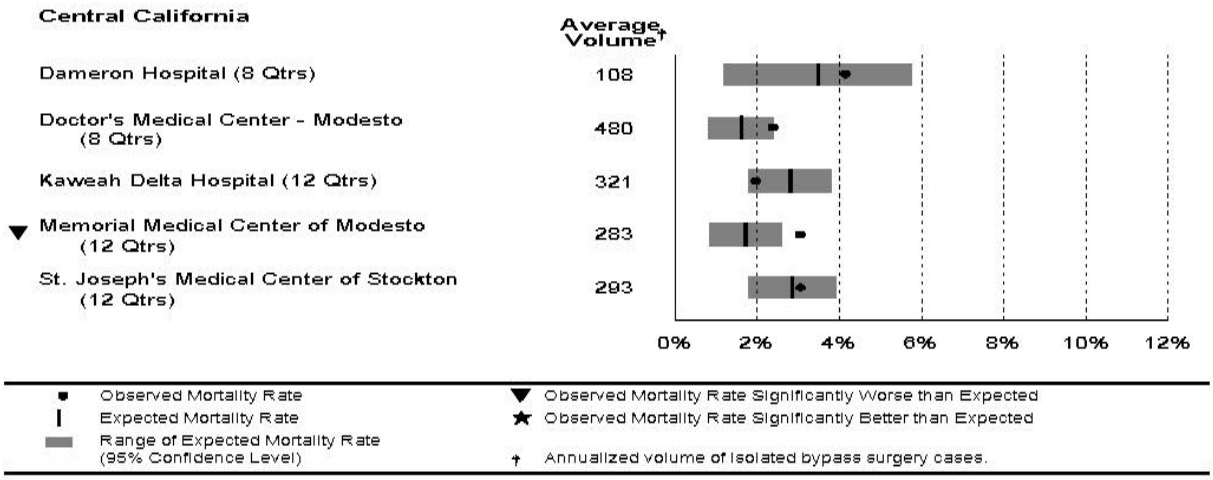
Hospital Name	Participation Period	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	O/E Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
Scripps Mercy*	Y99Q1-Y99Q4	256	16	8.32	1.92	6.25	1.16	3.25	5.34	Worse Than Expected
Sequoia Hospital	Y97Q1-Y99Q4	717	25	28.04	0.89	3.49	2.58	3.91	5.24	No Different
Seton Medical Center - Heart Institute	Y97Q1-Y99Q4	1730	30	36.60	0.82	1.73	1.45	2.12	2.78	No Different
Sharp Chula Vista Medical Center	Y97Q1-Y99Q4	821	29	32.28	0.90	3.53	2.66	3.93	5.20	No Different
Sharp Grossmont Hospital	Y98Q1-Y99Q4	281	4	6.65	0.60	1.42	0.61	2.37	4.12	No Different
Sharp Memorial Hospital	Y98Q1-Y99Q4	555	16	12.95	1.24	2.88	1.12	2.33	3.55	No Different
St. Bernardine Medical Center	Y98Q2-Y99Q4	962	25	24.78	1.01	2.60	1.60	2.58	3.55	No Different
St. Francis Medical Center	Y98Q2-Y99Q4	158	4	6.24	0.64	2.53	1.04	3.95	6.86	No Different
St. Helena Hospital	Y97Q1-Y99Q4	680	18	21.36	0.84	2.65	1.88	3.14	4.40	No Different
St. John's Hospital - Santa Monica	Y97Q1-Y99Q4	403	11	11.62	0.95	2.73	1.36	2.88	4.40	No Different
St. Joseph Hospital - Orange	Y98Q1-Y99Q4	606	12	14.70	0.82	1.98	1.25	2.42	3.60	No Different
St. Joseph's Medical Center of Stockton	Y97Q1-Y99Q4	879	27	25.13	1.07	3.07	1.81	2.86	3.91	No Different
St. Jude Medical Center	Y98Q1-Y99Q4	497	17	11.31	1.50	3.42	1.05	2.28	3.50	No Different
St. Mary's Hospital and Medical Center - SF*	Y99Q1-Y99Q4	553	10	15.85	0.63	1.81	1.51	2.87	4.22	No Different
St. Vincent Medical Center*	Y99Q1-Y99Q4	282	9	7.93	1.13	3.19	0.94	2.81	4.68	No Different
Stanford University Hospital	Y98Q1-Y99Q4	490	17	12.04	1.41	3.47	1.12	2.46	3.80	No Different
Summit Medical Center	Y97Q1-Y99Q4	522	12	22.43	0.54	2.30	2.79	4.30	5.81	Better Than Expected
Sutter Memorial Hospital	Y97Q1-Y99Q4	2157	37	65.70	0.56	1.72	2.36	3.05	3.73	Better Than Expected
The Hosp. of the Good Samaritan - Los Angeles*	Y99Q1-Y99Q4	649	25	26.16	0.96	3.85	2.58	4.03	5.48	No Different
Torrance Memorial Medical Center	Y97Q1-Y99Q4	603	27	21.27	1.27	4.48	2.16	3.53	4.89	No Different
Tri-City Medical Center	Y97Q1-Y99Q4	627	11	15.13	0.73	1.75	1.26	2.41	3.56	No Different
UC Irvine Medical Center	Y98Q1-Y99Q4	164	3	4.41	0.68	1.83	0.30	2.69	5.08	No Different

Table 7: Risk-Adjusted Results for CCMRP Hospitals, All Quarters (1997-1999), Sorted Alphabetically

Hospital Name	Participation Period	CABG Cases Submitted	Number of Observed Deaths	Number of Expected Deaths	O/E Ratio	Observed Death Rate	Lower 95% CI of Expected Death Rate	Expected Death Rate	Upper 95% CI of Expected Death Rate	Overall Performance Rating
UCD Medical Center	Y98Q3-Y99Q4	228	6	5.70	1.05	2.63	0.58	2.50	4.42	No Different
UCLA Medical Center	Y98Q1-Y99Q4	367	15	11.47	1.31	4.09	1.47	3.12	4.78	No Different
UCSF Medical Center	Y98Q1-Y99Q4	275	12	7.69	1.56	4.36	1.00	2.80	4.60	No Different
USC University Hospital	Y97Q1-Y99Q4	249	10	6.00	1.67	4.02	0.54	2.41	4.27	No Different
Washington Hospital - Fremont	Y97Q1-Y99Q4	502	27	27.03	1.00	5.38	3.63	5.39	7.14	No Different

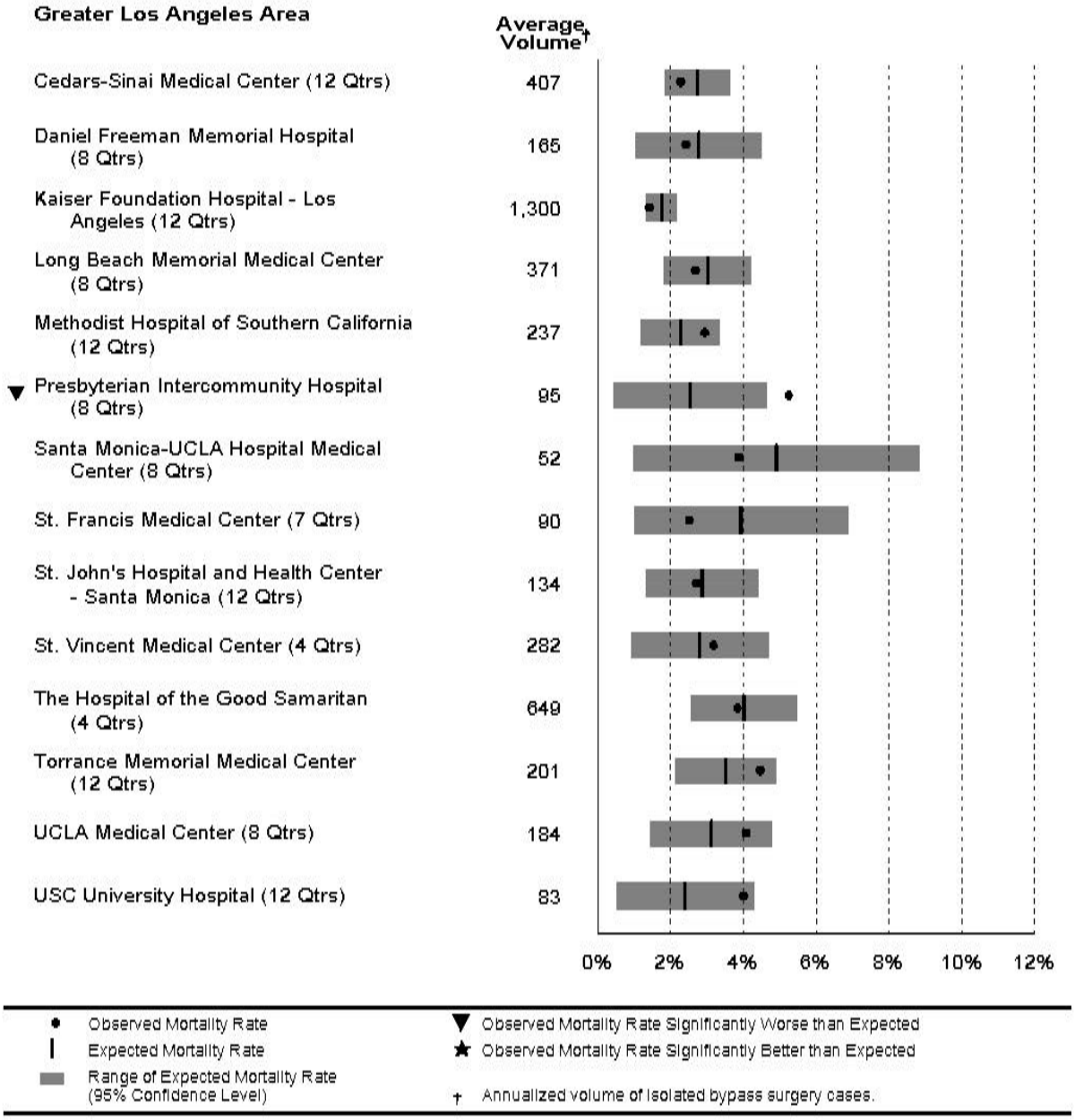
*An asterisk denotes hospitals that began participation in 1999. Their All Quarters result thus represents only four quarters of data.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(in Alphabetical Order by Geographic Region)



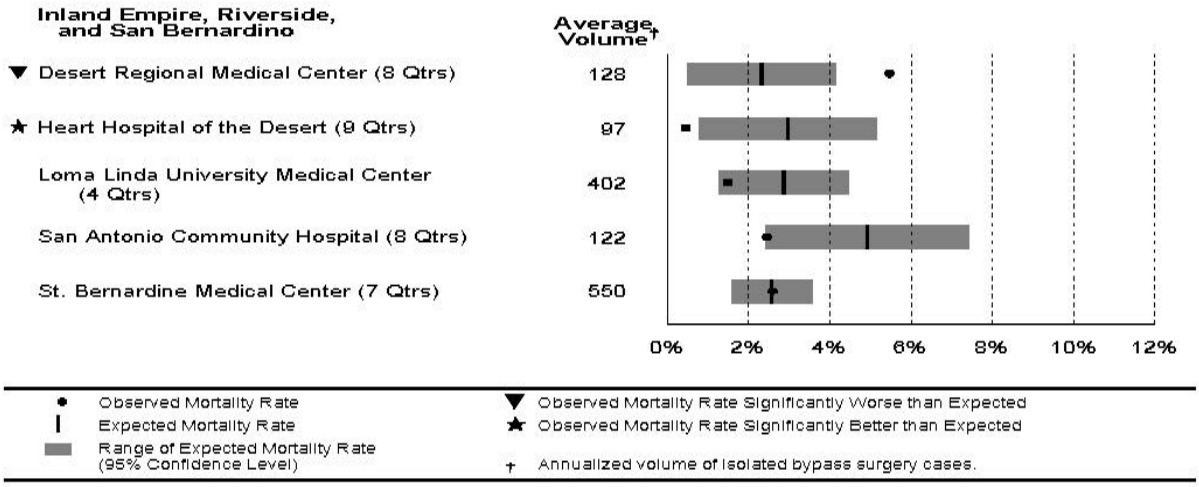
NOTE: The following hospitals in this region declined to participate:
Bakersfield Memorial Hospital, Fresno Community Hospital and Medical Center, Marian Medical Center, San Joaquin Community Hospital, St. Agnes Medical Center.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



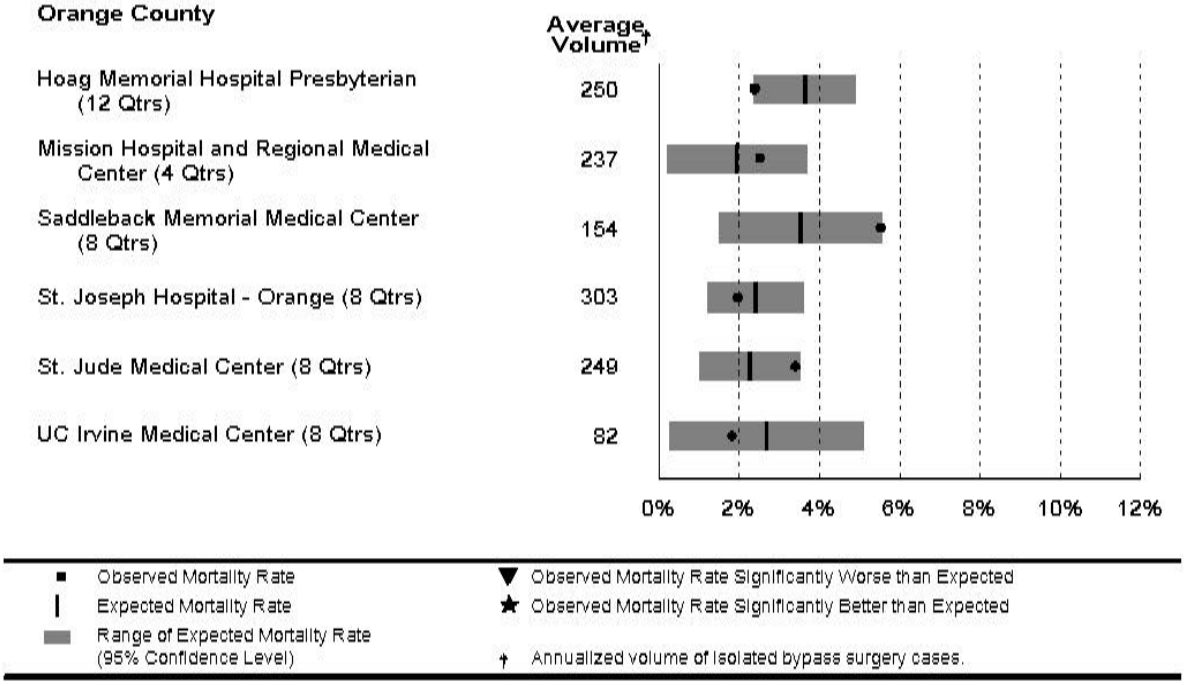
NOTE: The following hospitals in this region declined to participate:
Beverly Hospital, Brotman Medical Center, Centinela Hospital Medical Center, Downey Community Hospital, Garfield Medical Center, Huntington Memorial Hospital, Intercommunity/Citrus Valley Medical Center, LA County, Harbor-UCLA Medical Center, LA County/USC Medical Center, Lakewood Regional Medical Center, Little Company of Mary, St. Mary's Medical Center - Long Beach, White Memorial Medical Center.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



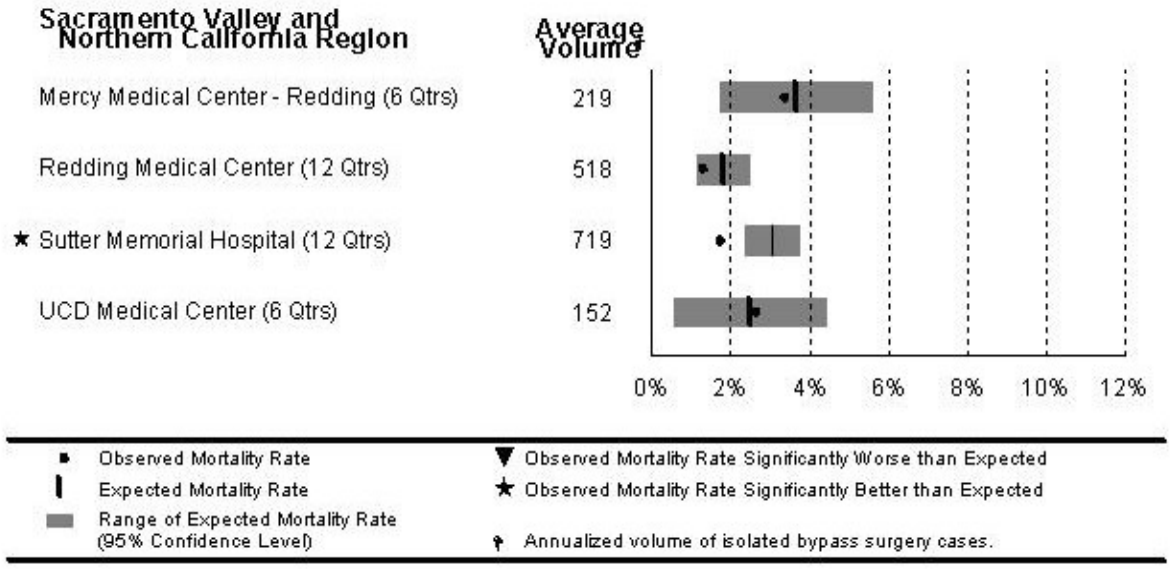
NOTE: The following hospitals in this region declined to participate:
Eisenhower Medical Center, Pomona Valley Hospital and Medical Center,
Riverside Community Medical Center, St. Mary's Regional Medical Center.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



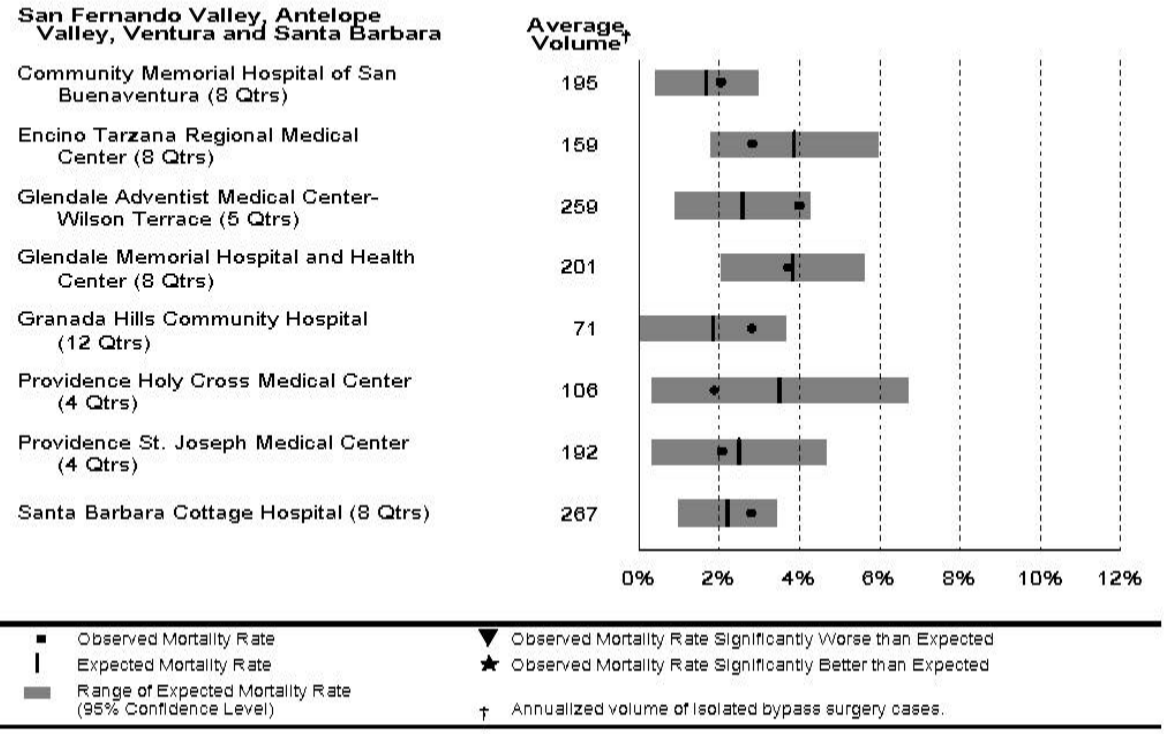
NOTE: The following hospitals in this region declined to participate:
Anaheim Memorial Medical Center, Fountain Valley Regional Hospital,
West Anaheim Medical Center, Western Medical Center - Anaheim,
Western Medical Center - Santa Ana.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



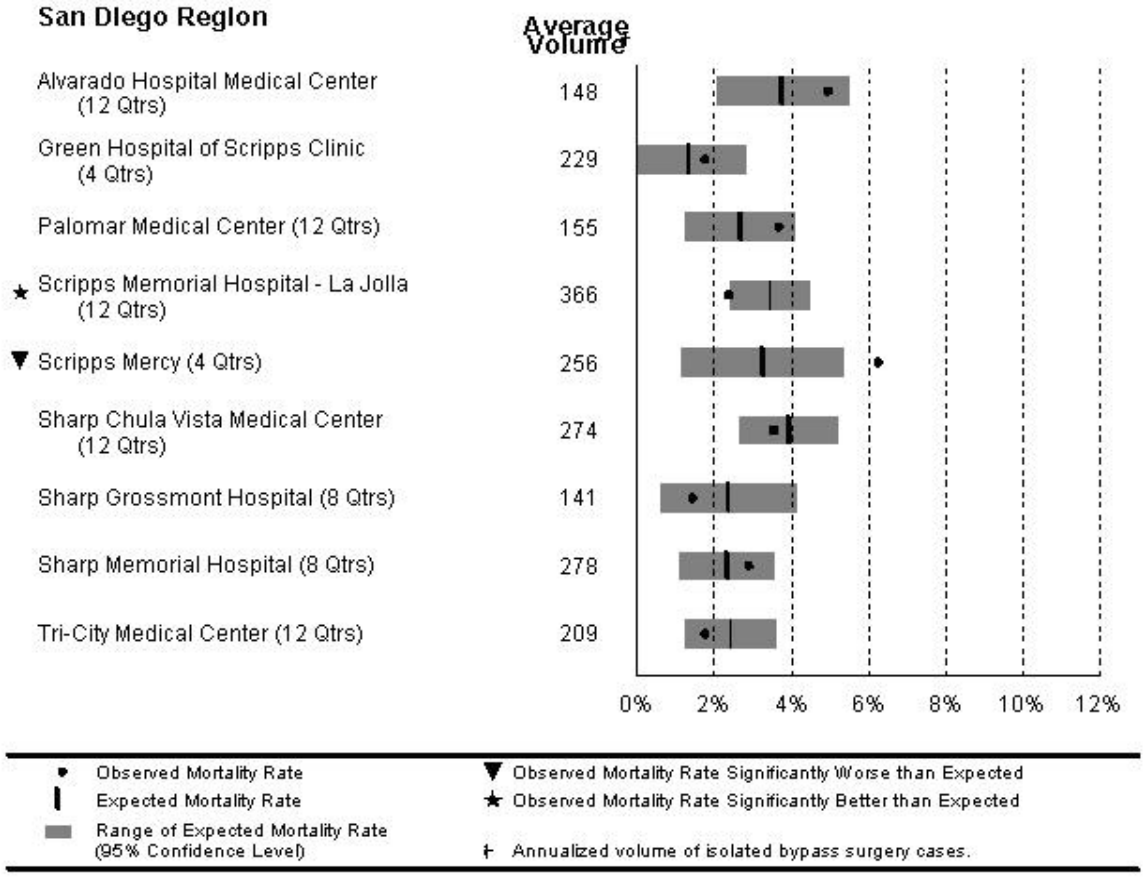
NOTE: The following hospitals in this region declined to participate:
Enloe Medical Center, Mercy General Hospital, Mercy San Juan Hospital.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



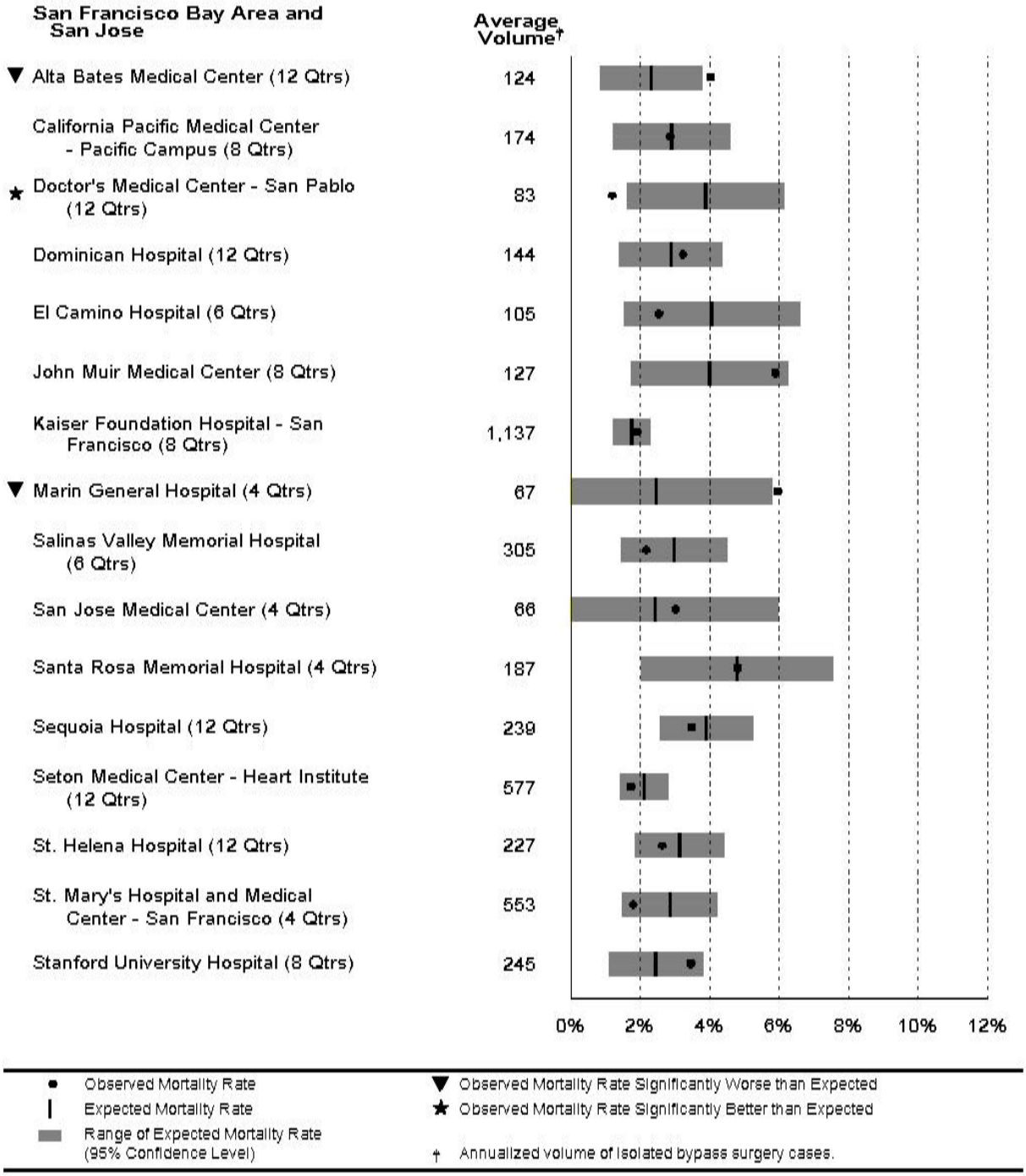
NOTE: The following hospitals in this region declined to participate:
Antelope Valley Hospital Medical Center, French Hospital - San Luis Obispo,
Lancaster Community Hospital, Los Robles Regional Medical Center,
Northridge Hospital Medical Center, St. John's Regional Medical Center - Oxnard,
Valley Presbyterian Hospital, West Hills Regional Medical Center.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



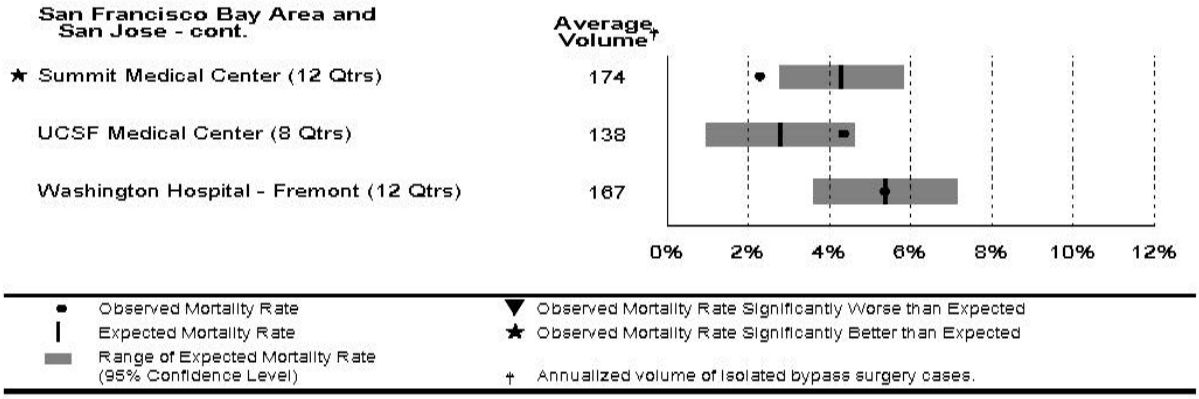
NOTE: The following hospitals in this region declined to participate:
UCSD Medical Center - Hillcrest, UCSD Medical Center - Thornton.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



NOTE: The following hospitals in this region declined to participate:
Good Samaritan Hospital - San Jose, Mt. Diablo Medical Center, O'Conner Hospital, Queen of the Valley Hospital, Santa Clara Valley Medical Center, Mills-Peninsula Hospital.

Figure 4: Comparison of Observed to Expected Mortality Rate, 1997-1999
(cont.) (in Alphabetical Order by Geographical Region)



NOTE: The following hospitals in this region declined to participate:
Good Samaritan Hospital - San Jose, Mt. Diablo Medical Center, O'Conner Hospital, Queen of the Valley Hospital, Santa Clara Valley Medical Center, Mills-Peninsula Hospital.

VI. MODEL FIT AND CALIBRATION

It is critical that the estimated models effectively represent the data and serve as a valid tool for risk adjustment. Earlier sections of this report addressed issues of data validity and content validity. This section evaluates the discrimination and calibration of the CCMRP model.

Discrimination

Models that distinguish well between patients who die and those who survive are said to have good discrimination. A commonly used measure of discrimination is the c-index (also known as the c-statistic, or the area under the ROC curve). The c-index ranges from 0 to 1, with higher values indicating better discrimination. For the **1999** data model the c-index is 0.834. For the **All Quarters** data model the c-index is 0.816. In comparison, c-indexes reported in other recently published studies of CABG mortality using logistic regression (including those from New Jersey, New York, Pennsylvania, and the Society of Thoracic Surgeons) range from about 0.78 to 0.82. As such, the CCMRP models appear to discriminate as well as, or better than, those from other programs that produce risk-adjusted outcomes data for isolated CABG surgery.

Calibration

Calibration refers to the ability of a model to match predicted and observed death rates across the entire spread of the data. A model in which the numbers of observed deaths align well with the numbers of deaths predicted by the model demonstrates good calibration. Good calibration is essential for reliable risk adjustment. A common measure of calibration is Hosmer and Lemeshow's χ^2-statistic, which compares observed and predicted outcomes over deciles of risk. The Hosmer-Lemeshow test statistic is 28.9 (df=8; p-value=0.00) for the **1999** model and 29.0 (df=8, p-value=0.00) for the **All Quarters** model (i.e., reject the null hypothesis of no difference between actual and predicted deaths). This result was not a major cause for concern; with such a large sample it is common to fail the Hosmer-Lemeshow test.

The next step was to inspect the difference between the actual number of deaths and the predicted number of deaths (derived from the risk model) in each of the 10 groups. These groups are created by sorting all observations by the predicted risk of death and then dividing the sorted observations into ten groups of approximately equal size.

Tables 8 and 9 show the calibration of the **1999** and **All Quarters** risk-adjustment models.

Table 8: Calibration of 1999 Model

Group	N	Minimum Predicted Risk	Maximum Predicted Risk	Actual Deaths	Predicted Deaths	Difference
1	2,198	0.03	0.31	1	4.7	(3.7)
2	2,198	0.31	0.50	6	8.9	(2.9)
3	2,197	0.50	0.71	8	13.2	(5.2)
4	2,197	0.71	0.97	8	28.3	(10.3)
5	2,197	0.97	1.28	19	24.5	(5.5)
6	2,197	1.28	1.72	41	32.6	8.4
7	2,197	1.72	2.38	40	44.5	(4.5)
8	2,197	2.38	3.51	90	63.4	26.6
9	2,197	3.51	6.23	113	101.5	11.5
10	2,197	6.23	86.91	295	309.5	(14.5)

Table 8 provides a summary comparison of the **1999** model to the data. There are a total of 21,973 patients in the 1999 CCMRP dataset. The first row of the table represents the decile of patients at lowest risk of in-hospital death in the CCMRP model (i.e., the 2,198 patients whose predicted risk of dying ranged from 0.03 to 0.31%). Among the first decile, one patient died, but the model predicted death for five of the patients. Assuming a Poisson distribution for a binary outcome with mean 0.0023 (5 ÷ 2,198), the predicted range of deaths for the first decile is 0.6 to 9.3 deaths. Thus, the one death that occurred falls within the expected range.

The last row of Table 8 represents the highest risk decile of patients for 1999. Among this group, 295 died whereas the model predicted 310 deaths. The predicted range for the tenth decile is 275 to 345 deaths. Again, the number of observed deaths falls within the expected range.

Table 9: Calibration of All Quarters Model

Group	N	Minimum Predicted Risk	Maximum Predicted Risk	Actual Deaths	Predicted Deaths	Difference
1	4,983	0.05	0.39	7	13.8	(6.8)
2	4,983	0.39	0.58	14	24.1	(10.1)
3	4,983	0.58	0.78	22	33.8	(11.8)
4	4,982	0.78	1.02	34	44.7	(10.7)
5	4,982	1.02	1.31	64	57.2	6.2
6	4,982	1.31	1.69	71	74.3	(3.3)
7	4,982	1.69	2.28	102	97.7	4.3
8	4,982	2.28	3.26	143	135	8.0
9	4,982	3.26	5.56	251	209.7	41.3
10	4,982	5.56	88.43	608	626.1	(17.9)

Figures 5 and 6 contain additional representations of the model calibration. The left panel of the graph plots the cumulative number of *predicted* deaths against the number of *actual* deaths. The closer the predictions are to the actual number of deaths, the closer the curve is to the superimposed 45-degree line. Overall, the predictions appear to track the actual observed deaths well.

The right panel plots the Actual and Predicted number of cumulative deaths against all **1999** and **All Quarters** cases respectively. The “smooth” curve summarizes the model predictions, while the slightly jagged curve represents the actual deaths. Because the models calibrate to the data well, the two curves lie close to each other. In addition, both curves are relatively flat on the left side and increase rapidly as they move toward the right, akin to so-called “exponential” curves. This suggests that the majority of CABG surgeries are low in risk and that most in-hospital deaths occur in higher-risk patients. For 1999, only 42 deaths occurred among the 10,988 patients that fall in the lower half of the risk profile. Conversely, the remaining 579 deaths are concentrated in the 10,985 cases in the upper half. Although the overall in-hospital mortality rate following isolated CABG surgery is only 2.83%, the average risk of death for those in the lower half of the risk profile is 0.6% as opposed to 5% in the upper half. Although the graph does not show it, a straight line connecting the lower leftmost point with the upper rightmost point identifies a “constant risk” line of 2.83%, and would serve to demonstrate the importance of risk adjusting CABG data.

Three features stand out about the calibration of the model:

- The majority of cases exhibit low risk. Nonetheless, the range of predicted risks (from almost zero to almost 90%) seems adequately wide, suggesting that the model does cover the entire range of risk levels. This should ease concerns that the risk models cannot adequately adjust for high-risk patients.
- The model fits quite well in the higher risk categories. For 1999, among patients whose predicted risk exceeds 6.23%, the number of predicted deaths (408) approximates the number of observed deaths (412). This suggests that the risk-adjustment model works quite well for higher risk patients. As such, the model does not provide an incentive for hospitals to exclude high-risk patients from appropriate surgeries in order to improve their risk-adjusted rates.
- There is evidence that the model over-adjusts at the lowest risks, but this evidence is not statistically significant and the over-adjustment is relatively small.[18]

[18] A test was performed to determine whether the expected range covers the number of observed events in each group. Only for group 8 in the 1999 analysis is the observed count of deaths outside the range of the expected deaths.

Figure 5: Calibration of 1999 Model

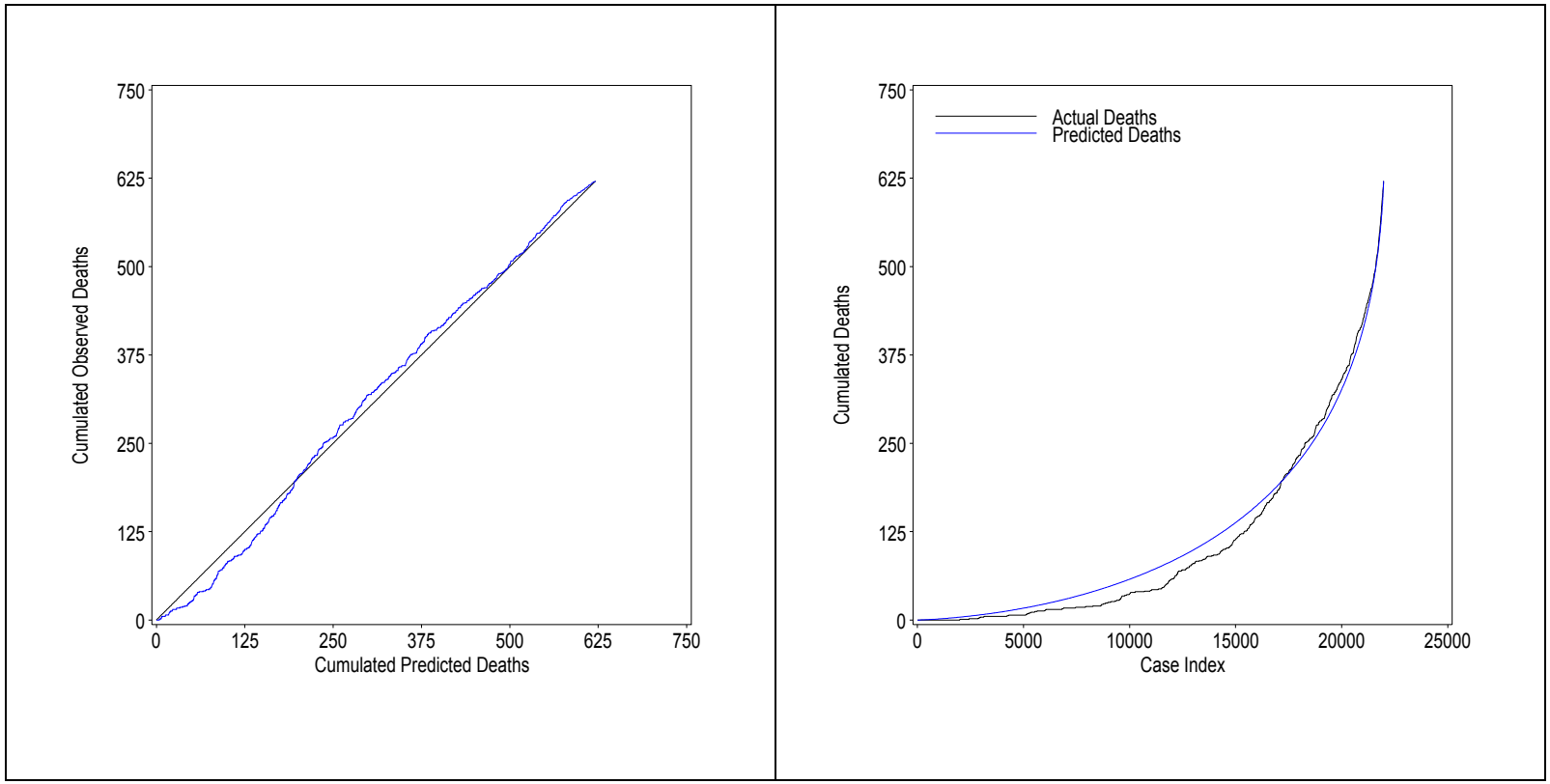
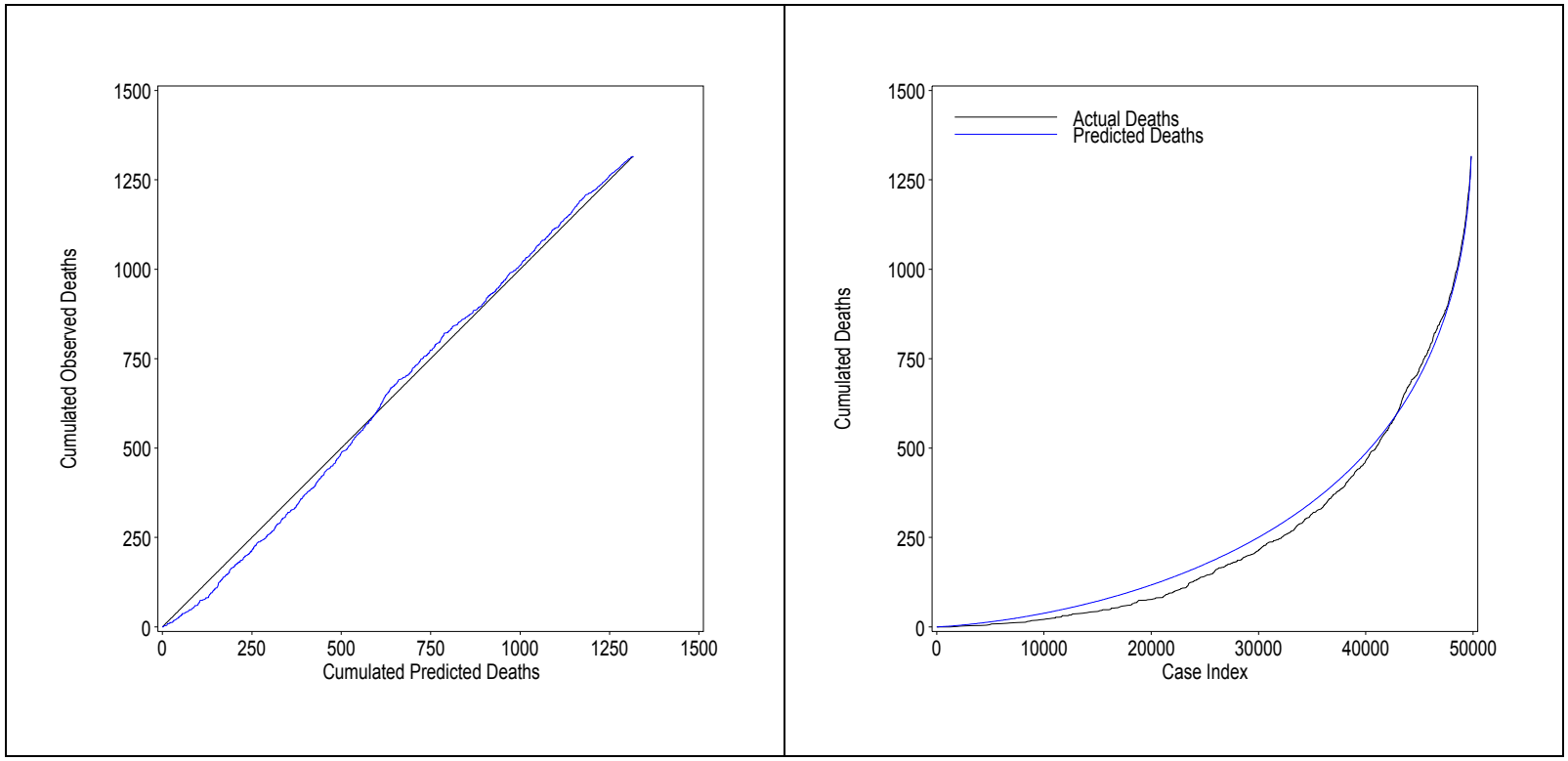


Figure 6: Calibration of All Quarters Model



VII. HOSPITAL VOLUME AND CORONARY ARTERY BYPASS GRAFT SURGERY OUTCOMES

A number of studies have found a statistically significant relationship between the annual number of bypass surgeries a hospital performs and mortality (Farley, 1992; Hannan et al., 1989; Hannan et al. 1991; Showstack et al., 1987; Dudley et al., 2000). On average, hospitals that perform a higher volume of coronary bypass procedures tend to achieve better outcomes– meaning they tend to have a lower death rate from the operation as compared to lower volume hospitals.

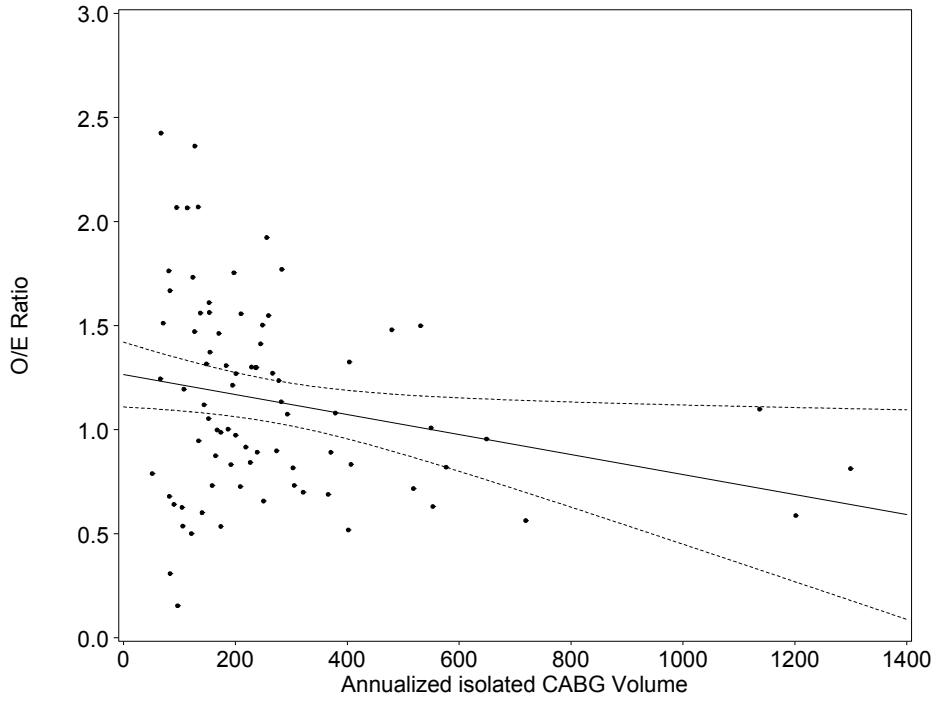
The CCMRP data provides a unique opportunity to examine whether there is a relationship between surgical volume and outcome as measured by in-hospital mortality. This is particularly important given the large proportion of low volume institutions that exist in California as compared to other states, such as New York, where the volume outcome relationship has been examined. Out of 33 hospitals performing bypass surgery in New York during 1999, 16 (48.5% of all hospitals) performed 500 or more cases annually as compared to 10 out of 119 in California (8.4% of all hospitals). Only 7 hospitals in New York (21%) performed fewer than 300 cases annually, as compared to 95 (80%) in California.

Risk-adjusted outcomes data are a better measure of a hospital's performance than the volume of cases, particularly since some small volume hospitals are able to achieve good outcomes. However, in the absence of outcomes data—which is the case for 49 of the 119 California hospitals that do CABG, as well as for most hospitals nationally—the annual volume of bypass surgeries a hospital performs is one of the few proxy measures of performance available to the public. The Leapfrog Group (2002) is using CABG volume as one of its markers of patient safety in the absence of outcome results.

Figure 7 shows the relationship between annual CABG volume and average hospital outcomes over a three-year period in California. For hospitals that did not submit three years of complete data, results and case counts were annualized. Hospital outcomes are captured by the *Observed to Expected Ratio*, or the O/E ratio (refer to Section IV for a description of the O/E ratio). Each dot in the figure identifies a single hospital. For example, the dot near the upper left corner of the figure represents a hospital whose mean annual volume was 67 CABG cases for 1997-1999, with an O/E ratio of 2.45. The rightmost dot in the figure represents a hospital that averaged 1,300 cases per year and had an O/E ratio of 0.84.

A regression line through these points has a slightly negative slope. The slope is statistically significant (two-tailed test, p-value=0.03). The graph shows wide variation in performance among lower volume hospitals (i.e., those with fewer than 300 cases annually) as compared with higher volume hospitals.

Figure 7: The Relationship Between Isolated CABG Volume and Hospital Outcomes CCMRP Hospitals, 1997-1999



To understand the effects of size at an aggregate level, hospitals were assigned to approximate quartile groupings based on their annualized volume. Rather than calculating O/E Ratios for each hospital separately, we aggregated calculations across hospitals in each grouping. Table 10 displays details of allocating hospitals to four groups based on the average annual number of isolated bypass surgeries performed. Using the predicted values from our fitted model, we calculated the expected mortality based on our model and compared it to the observed mortality for each volume group.

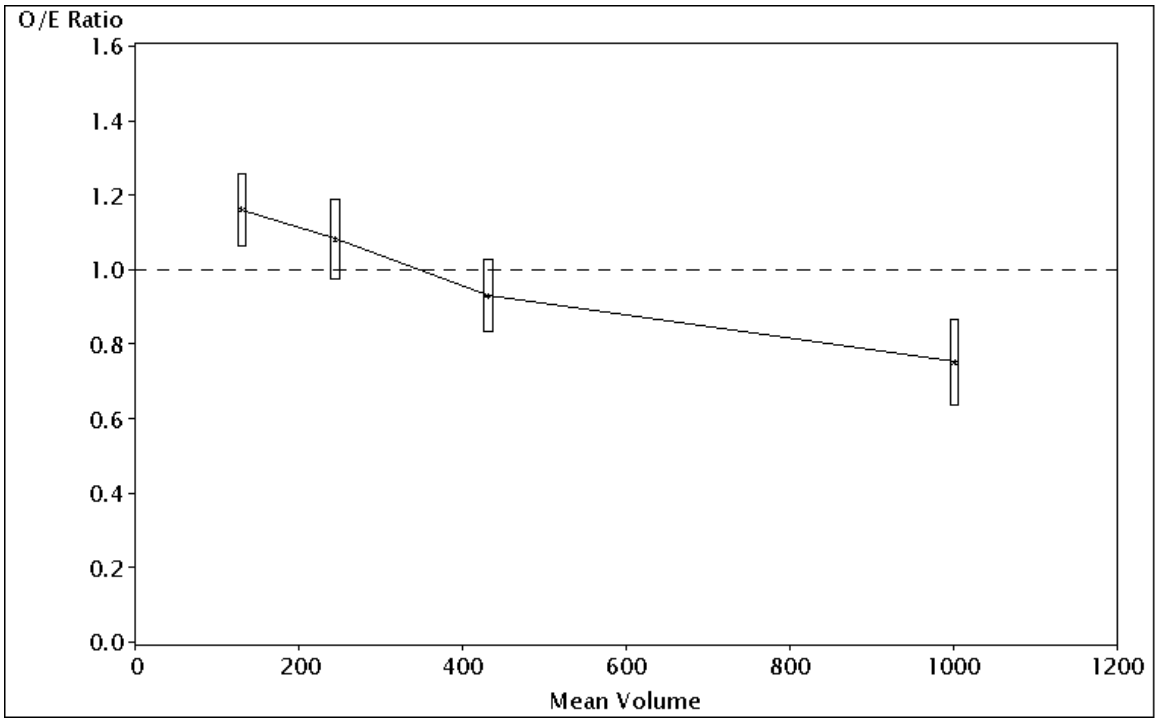
Table 10: CCMRP Hospitals by Volume, 1997-1999

Average Volume per Year	Number of Hospitals	Mean Annualized Volume	Total Number of Cases in 1997-1999*	Percent of Cases in 1997-1999
< 200	40	130	11,603	23.29
200 to 299	21	245	10,979	22.04
300 to 599	15	431	14,657	29.42
>=600	5	1001	12,584	25.26
Total	81	269	49,823	100.00

Note: The mean annualized volume multiplied by the number of hospitals in each volume group is generally larger than the total number of cases submitted by hospitals for 1997-1999 since some hospitals had partial-year 1997-1998 data submissions.

Figure 8 shows the O/E ratio and 95% confidence limits for each of the four volume groups. The O/E ratio is 1.15 (95% CL: 1.07-1.26) for the first group of hospitals with annualized volumes below 200 cases, 1.09 (95% CL: 0.99-1.20) for the second group with annualized volumes of 200 to 299 cases, 0.92 (95% CL: 0.84-1.03) for the third group, and 0.75 (95% CL: 0.64-0.87) for the highest volume group. The figure shows significantly better outcomes for the third and fourth volume groups when compared to the first group (<200 cases annually). In addition, the fourth volume group has significantly better outcomes than the second group (200 to 299 cases annually).

Figure 8: Relationship Between Average CABG Volume and Average Hospital Outcomes, 1997-1999



The analysis of the 1997-1999 CCMRP data supports findings from other studies that risk-adjusted in-hospital mortality and volume are related. While it is true that, on average, smaller volume hospitals tend to perform worse than larger hospitals and experience wide variation in performance, Figure 7 also shows that a number of smaller volume hospitals were able to achieve good outcomes. In the All Quarters analysis, three low volume hospitals did achieve good outcomes, performing "better than expected." Finally, this analysis has not attempted to assess the relative importance of volume as a predictor of in-hospital mortality. Such information would be a valuable contribution to current policy discussions.

APPENDICES

APPENDIX A: CLINICAL DEFINITION OF ISOLATED CABG FOR DATA YEAR 1999

When any of the procedures listed in Section A were performed concurrently with coronary artery bypass surgery the case was deemed non-isolated. It is not possible to list all procedures because cases can be complex and clinical definitions are not always precise. Only cardiac procedures have been listed.

Section A

- Valve procedures
- Operations on structures adjacent to heart valves (papillary muscle, chordae tendineae, traebeculae carneae cordis, annuloplasty, infundibulectomy)
- Ventriculectomy
- Repair of atrial and ventricular septa
- Excision of aneurysm of heart
- Head and neck, intracranial endarterectomy
- Other open heart surgeries, such as aortic arch repair, pulmonary endartectomy
- Endarterectomy of aorta
- Thoracic endarterectomy (endarterectomy on an artery outside the heart)
- Heart transplantation
- Repair of certain congenital cardiac anomalies (e.g., tetralology of fallot, ASD, VSD, valvular abnormality)
- Implantation of cardiomyostimulation system (note: refers to cardiomyoplasty systems only, other heart-assist systems such as pacemakers or ICDs not excluded)
- Any aortic aneurysm repair (abdominal or thoracic)
- Aorta-subclavian-carotid bypass
- Aorta-renal bypass
- Aorta-iliac-femoral bypass
- Caval-pulmonary artery anastomosis
- Extracranial-intracranial (EC-IC) vascular bypass

If a procedure listed in Section B below was performed concurrently with coronary artery bypass surgery, the case was considered an isolated CABG, unless a procedure listed in Section A was performed during the same surgery.

Section B

- Transmyocardial laser revascularization (TMR)
- Pericardiectomy and excision of lesions of heart
- Repair/restoration of the heart or pericardium
- Coronary endarterectomy
- Pacemakers
- ICDs

APPENDIX B: VARIABLE SELECTION

In initially determining the data elements to be collected for CCMRP, staff reviewed a consensus statement prepared by a panel of researchers from the major reporting programs including the STS, the New York State Department of Health, the Northern New England Cardiovascular Consortium, the Parsonnet group, and the Veterans Affairs (Jones et al., 1996). The analysis identified seven "core" pre-operative variables that were unequivocally related to mortality, 13 "Level 1" variables that are likely to have a relationship and are suggested for inclusion, and 24 "Level 2" variables not clearly shown to relate directly to short-term CABG mortality. Staff presented this information to the Technical Advisory Panel (TAP) for its review and discussion. In 1996, the TAP recommended collection of all Core and Level 1 variables, and the majority of Level 2 variables identified by Jones et al. for CCMRP.

Table B-1: Variable Selection

Category	Core Variables	Level 1 Variables	Level 2 Variables
Demographics	Age Gender	Height Weight	Race Educational level Marital status Location of residence
Administrative			Institution where CABG performed Surgeon responsible for CABG Payment source
History	Previous heart operation	PTCA on current admission Date of most recent MI Angina history	Date of last cardiac operation Number of previous CABG surgeries Angina on admission Number of previous PTCAs Date of most recent PTCA Number of previous MIs
Left ventricular function	Left ventricular ejection fraction		Left ventricular end-diastolic pressure
Left main disease	% stenosis left main coronary artery		
Other cardiac conditions		Serious ventricular arrhythmias Congestive heart failure Mitral regurgitation	
Cardiovascular risk factors		Diabetes Cerebrovascular disease Peripheral vascular disease	Smoking Hypertension Diabetes sequelae
Co-morbid conditions		COPD Creatinine levels	Cardiac pacemaker Refusal of blood products Substance abuse Liver disease Malignancy Immunosuppressed state
Acuity	Elective Urgent Emergent/ongoing ischemia Emergent/hemodynamic instability Emergent/salvage		Hospital location before operation

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
Date of Surgery	mm-dd-yy	
Gender	Male, female	
Date of Birth	mm-dd-yy	
Race/Ethnicity	Caucasian, Black, Hispanic, Asian, Native American, or other.	
Insurer	Primary payer: Medicare, Medicaid, private/corporate, CHAMPUS, or uninsured.	
Patient's Zip Code		
Height	Centimeters	
Weight	Kilograms	
Creatinine Level	mg/dl. Serum creatinine at time of surgery.	The STS *form* asks for the "highest creatinine" while the *STS Terms and Definitions* guide asks for the most recent pre-operative creatinine. Please follow the guide, i.e., code the most recent pre-operative value. Note also that beginning 1/1/99, the STS will collect this data element for all cases.
Hypertension	Blood pressure exceeding 140/90 mm Hg or a history of high blood pressure, or the need for anti-hypertensive medications.	Beginning 1/1/99, the STS proposes to change this definition to: 1. Documented history of HTN diagnosed and treated with medication, diet and/or exercise. 2. BP $\geq$140/90 on 2 occasions. 3. Normotensive but currently on anti-hypertensive medication.
Dialysis	Hemodialysis or peritoneal dialysis.	Check this box if the patient is *currently* on dialysis, not if the patient has ever been on dialysis. This is consistent with the proposed STS definition.
Diabetes	A history of diabetes, regardless of duration of disease or need for anti-diabetic agents.	Note that this is a very liberal definition of diabetes.
Peripheral Vascular Disease	A history of aneurysm and/or occlusive vascular disease with or without previous extra-cardiac vascular surgery.	As of 1/1/99, the STS proposes to change this definition to: "The patient has PVD, as indicated by any or all of: claudication either with exertion or rest; amputation for arterial insufficiency; aorto-iliac occlusive disease reconstruction; peripheral vascular bypass surgery, angioplasty, stent documented AAA, AAA repair or stent; documented positive non-invasive testing." Cerebrovascular disease is not included in peripheral vascular disease, since it has its own data element.
Cerebrovascular Disease	Any TIA, RIND, CVA, or history of cerebrovascular surgery.	As of 1/1/99, the STS proposes to change this definition to: "The patient has a documented history of: CVA (symptoms > 72 hrs after onset); RIND (recovery with 72 hrs); TIA (return within 24 hrs); unresponsive coma > 24 hrs; non-invasive carotid test with > 75% occlusion."

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions (cont.)

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
Ventricular Arrhythmia	Abnormal rapid ventricular rhythm causing hemodynamic collapse (tachycardia) or diffuse chaotic ventricular depolarization unable to produce an effective blood pressure.	Ventricular arrhythmia does NOT refer to frequent PVC's (premature ventricular beats), bigeminy, or non-sustained ventricular tachycardia. Note that as of 1/1/99, the STS proposes to change this definition to: "Within two weeks of the procedure, clinical documentation of sustained VT or VF requiring cardioversion and/or IV antiarrhythmics."
Myocardial Infarction	A patient is considered to have had a myocardial infarction if there is documented evidence of a: transmural infarction defined by the appearance of a new Q wave in two or more contiguous leads on ECG, or subendocardial infarction (non Q wave), which is considered present in a patient having clinical, angiographic, electrocardiographic, and/or laboratory isoenzyme evidence of myocardial necrosis with an ECG showing no new Q waves.	Check this box if the patient has *ever* had an MI. For STS users, we will collect the data element "MI" and not the element "MI Type." Note that as of 1/1/99, the STS proposes to change this definition to: "1. Patient hospitalized for an MI documented in the medical record. 2. Two of four criteria are necessary: prolonged (> 20 min) "typical" chest pain not relieved by rest and/or nitrates; enzyme level elevation; CK-MB > 5% or total CPK CK greater than 2x normal; LDH subtype 1 > LCH subtype 2; troponin > 0.2 µg/ml; new wall motion abnormalities; 3. Serial ECG (at least two) showing changes from baseline or serially in ST-T and/or Q waves that are 0.03 seconds in width and/or > or + one third of the total QRS complex in two or more contiguous leads."
Date/Time of Most Recent MI	STS data element "MI When: < 6 hrs., >6 but < 24 hrs., 1-7 days, 8-21 days, >21 days" refers to the last documented infarction.	For STS users, we will collect the variable "MI When." For users of CCMRP, we will collect date of MI and calculate the interval from MI to surgery.
Number of Prior Cardiac Operations Requiring Cardiopulmonary Bypass	Prior to this operation being recorded, which may be during this admission, how many cardiac surgical operations were performed on this patient utilizing cardiopulmonary bypass.	Note that we do not code re-dos on the same admission separately. In addition, we *may* update this definition later to reflect "minimally invasive" procedures done "off-pump."
Date of Most Recent Cardiac Operation	This is the definition for the STS variable "Date of most recent CV intervention": Date patient having undergone any previous cardiac procedure, which may be during current admission. For STS users, either record the date of the most recent cardiac operation in this field or, if you have added a customized field for this data element, record it there.	Enter the date of the most recent cardiac operation (CABG, valve surgery, intracardiac repair). Do *not* record the date of the prior PTCAs, non-cardiac vascular surgeries, pacemaker or defibrillator implantations, or other interventions. Note that there is some ambiguity on the STS data collection form, which asks for "Previous CV intervention: most recent" while the STS Terms and Definitions makes it clearer that cardiac procedures, and not vascular procedures, are the real target. In addition, the STS form makes it difficult to tell whether the most recent CV intervention was a bypass, a PTCA, or some other procedure since one can "check-off" more than one box, and the date of the last catheterization is captured under "Catheterization Data".
Number of Prior PTCAs	Total number of previous PTCA/Atherectomy procedures prior to the cardiac surgical procedure.	The number of PTCAs refers to the number of separate procedures (including any performed during the current hospitalization), NOT the number of vessels dilated.
PTCA/Atherectomy During Current Admission	Was the interventional cardiologic procedure performed during the same in-patient admission as the current operation? Yes/No	
PTCA to Surgery Time Interval	<6 hrs., >6 hrs.	If PTCA occurred during this admission. Note beginning 1/1/99, the STS proposes to rename this data element "Unplanned CABG" and to collect the date and time of the last intervention, and date and time of the last surgical intervention.

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions (cont.)

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
Chronic Obstructive Pulmonary Disease	A patient who requires pharmacologic therapy for the treatment of chronic pulmonary compromise, or a patient who has a FEV1 < 75% of predicted value.	After 1/1/99, the STS proposes to change the name of this data element to "Chronic Lung Disease," and to replace the existing definition with: "Patient with clinical documentation of any of the following: pharmacologic Rx (inhalers, theophylline/aminophylline, steroids); FEV1 < 75%; RA pO2 < 60; RA pCO2 > 50." Patients do NOT have COPD merely on the basis on a heavy smoking history or being labeled "COPD" in the chart *without other documentation*.
Congestive Heart Failure	At least three of the following: 1) presence of dyspnea; 2) rales thought to represent pulmonary congestion; 3) peripheral edema; 4) cardiomegaly on chest x-ray; 5) chest x-ray compatible with interstitial edema.	Note: as of 1/1/99, the STS proposes to change this definition to: "1. Within 2 weeks prior to procedure. Physician Dx of CHF is made. 2. Within 2 weeks prior to procedure, one or more are present: PND; dyspnea on exertion due to heart failure; pulmonary congestion on CXR. 3. Pedal edema or dyspnea alone are not diagnostic. 4. Pt should have received diuretics or digoxin." Note also that NYHA function class (below) refers only to the severity of the patient's heart failure *at the time of surgery*, and not to the severity of heart failure in the past.
Angina (yes/no)		Check this box if the patient has *ever* had angina.
Unstable Angina	Stable: Angina which is controlled by oral or transcutaneous medication. Unstable: The presence of on-going refractory ischemia that requires hospitalization in an intensive care unit and use of intravenous nitrate therapy for control.	The current STS definition of unstable angina requires hospitalization in an ICU and treatment with intravenous nitroglycerin. However, beginning 1/1/99, the STS proposes to replace this with Angina at rest (>20 min); or new onset (<2 months); or CCSC III angina; or recent acceleration in pattern and increase of one CCS class to CCS III; or variant angina; or non-Q MI; or post-infarction angina (>24 hrs); or "Clinical Classification" (IV nitrates (or equivalent), IV heparin (or equivalent), and telemetry monitoring). Patients with myocardial infarctions who present with angina should have their angina type and CCS class coded in addition to their myocardial infarction. Thus, a patient presenting with angina at rest who is subsequently diagnosed with a myocardial infarction would have angina=yes, type=unstable, CCS=class IV, MI=yes.

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions (cont.)

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
NYHA (New York Heart Association) Functional Class (for Congestive Heart Failure).	I= Patients with cardiac disease but without resulting limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea, or angina. II= Patients with cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitations, dyspnea, or anginal pain. III= Patients with cardiac disease resulting in marked limitation of physical activity. They are comfortable at rest. Less than ordinary physical activity results in fatigue, palpitations, dyspnea, or anginal pain. IV= Patients with cardiac disease resulting in inability to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency or of the anginal syndrome may be present even at rest. If any physical activity is undertaken, discomfort is increased. If this information is not defined in the patient's chart, the minimum data requirement is the notation of a NYHA status to be calculated by the data manager using the patient's recorded history and the detail definition of the three scales. Asymptomatic patient should be classified as a NYHA Class I. NYHA class should be utilized to determine functional class secondary to heart failure.	NYHA class refers to the severity of *recent* heart failure (within two weeks of surgery) and not to past episodes of CHF. If a patient has a history of heart failure but is well compensated with no or only minimal symptoms at the time of surgery, the patient is coded as NYHA=class I, CHF=yes.

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions (cont.)

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
CCS (Canadian Cardiovascular Society) angina class	I= Ordinary physical activity does not cause angina. Angina may occur with strenuous, rapid or prolonged exertion at work or recreation. II= There is slight limitation of ordinary activity. Angina may occur with walking or climbing stairs rapidly, walking uphill, walking or stair climbing after meals or in the cold, in the wind, or under emotional stress, or walking more than two blocks on the level, and climbing more than one flight of stairs at normal pace under normal conditions. III= There is marked limitation of ordinary physical activity. Angina may occur after walking one or two blocks on the level or climbing one flight of stairs under normal conditions at a normal pace. IV= There is inability to carry on any physical activity without discomfort; angina may be present at rest.	CCS angina class refers to the highest *recent* class (in the two weeks before surgery). Patients who have *never* had angina are coded as angina=no, CCS=class I. Class I also refers to patients who have had angina in the past but are now *asymptomatic* and to patients who have symptoms only with strenuous activity (both would be angina=yes, CCS=class I). Patients with angina at rest or with even minimal activity are class IV (this includes many patients with unstable angina). Classify angina when present even for patients with myocardial infarctions. Thus, code a patient presenting with chest pain at rest and a myocardial infarction as angina=yes, angina unstable=yes, CCS=class IV, MI=yes.

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions (cont.)

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
Acuity (elective, urgent, emergent, or salvage)	Refers to the severity of the patient's condition in the immediate pre-operative time period. An elective operation is one that is performed on a patient with cardiac function that has been stable in the days or weeks prior to operation. Elective cases are usually scheduled at least one day prior to the surgical procedure. An urgent operation is one which surgery is required within 24 hours in order to minimize the chance of further clinical deterioration. Typical patients include those with sudden, worsening chest pain and/or congestive heart failure, life-threatening coronary vascular anatomy, or those who are symptomatic at rest. Delay in operation in necessitated only by attempts to improve the patient's condition, availability of a spouse or parent for informed consent, availability of blood products, or the availability of results of essential laboratory procedures or tests. An urgent status is not merited by left main disease alone, use of heparin infusions, or purely administrative considerations. Patients requiring emergency operations will have ongoing, refractory, unrelenting cardiac compromise, with or without hemodynamic instability, and not responsive to any form of therapy except cardiac surgery. An emergency operation is one in which there should be no delay in providing operative intervention. Emergent/salvage: Patient undergoing CPR en route to the operating room or prior to induction of anesthesia.	Status refers to the patient's condition immediately *before surgery*; it should not reflect instability which occurs after the induction of anesthesia or the operative outcome. Status does not assess operative risk but rather how expediently surgery must be performed. Thus, some elective patients may be at higher risk than urgent patients; for example, an elderly patient with an ejection fraction of 20% and COPD operated on electively compared to a young patient with a normal ejection fraction who has ongoing unstable angina. Elective surgeries are performed on patients whose cardiac function has been stable. They are usually scheduled at least one day prior to surgery, and the clinical picture allows discharge from the hospital with readmission for surgery later. A surgery is elective even if the patient was operated on during a hospitalization for an acute coronary syndrome if they *could have been discharged* to have their surgery at a later date. Elective patients are at a low risk for morbidity or death outside of the hospital given good medical management and restricted activities. Urgent surgeries are performed on patients whose medical condition requires continuous hospitalization prior to CABG. The patients may be operated on in the next available surgical suite but would not necessarily take precedence over an elective case and, *clarifying the STS definition,* could wait more than 24 hours, possibly several days. A critical feature that distinguishes urgent from elective patients is that urgent patients *cannot be safely discharged* prior to their CABG, but they can safely await CABG in the hospital. An intra-aortic balloon pump or IV nitroglycerin may be part of treatment. Emergent surgeries are performed on patients whose condition dictates that the surgery be performed within several hours to prevent morbidity or death. These cases should take precedence over an elective case, cause a new operating room to be opened, or be done at night or on a weekend if necessary. A critical feature which distinguishes emergent from urgent patients is that emergent patients *cannot safely delay CABG even while they are in the hospital.* Salvage surgeries are performed on a patient undergoing CPR en route to operating room or in the operating room prior to induction of anesthesia.
Ejection Fraction (%)		Most recent prior to surgery

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions (cont.)

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
Method of Measuring Ejection Fraction (LV gram, radionuclide, or echocardiogram)		Ejection fraction is determined by one of the following methods (in order of preference): Left ventriculogram, radionuclide scan, or echocardiogram. Ejection fraction (EF) is an important predictor of risk. Make every effort to obtain it when available. Use the last determination of EF prior to surgery. When an official report gives both a calculated EF and an estimated EF, use the calculated value. The EF must be obtained from the official report of one of the above three studies; do not use an "estimate", which, in contrast to the STS system, will be considered the same as a missing value. If a range of EFs are given, enter the mean value (e.g. for "30 to 35%", enter "32" - the STS system has no space for 32.5). If the EF or "left ventricular function" is described qualitatively, enter as follows: normal = 65%, mildly reduced = 50%, moderately reduced = 35%, and severely reduced = 20%. Transesophageal echocardiograms (TEEs) done during surgery should not be used as a source for either mitral regurgitation or EF, unless it is the only available study, because operative conditions can artifactually alter both mitral regurgitation and ejection fraction.
Left Main Stenosis (%)	% value	
Coronary Disease - Number of Vessels	None, single, double, triple. The number of major (LAD system, Cx system, Right system) coronary vessels with > 50% narrowing in any angiographic view. Enter *none* if only left main disease.	The number of vessels refers to the number of major coronary arteries which are diseased. Consider a major coronary artery as diseased if it or one of its first order branches has a >50% stenosis. The three major coronary arteries and their first order branches are 1) the left anterior descending (LAD) with its branches the diagonals; 2) the circumflex (Cx) with its branches the obtuse marginals (OM's) or circumflex marginals; and 3) the right coronary artery (RCA) with its branch the posterior descending artery (PDA). Consider left main disease separately from the LAD and circumflex. Thus, code the "number of vessels" as "none" for a patient has stenosis of the left main but not the LAD, circumflex, or RCA. When the posterior descending artery (PDA) is supplied by the circumflex (i.e., when the circumflex instead of the right coronary artery is dominant), count the PDA (but NOT the non-dominant RCA) as a major vessel. Thus, a patient with stenoses of the LAD, an obtuse marginal branch off of the circumflex, and the PDA off of the circumflex would be coded as having triple vessel disease (even if the non-dominant right coronary is normal). When a large ramus medianus branch supplies part of the LAD or circumflex distribution, count the ramus as a first order branch of one of those vessels. Thus, a patient with stenoses of the ramus, circumflex, and RCA may be counted as 3 vessel disease (however, do NOT count 3 vessel disease if disease involves the LAD, circumflex, and ramus but not a dominant RCA). NOTE: the number of major arteries which are counted as diseased may differ from the number of bypass grafts placed (e.g., a graft may be placed to a vessel with < 50% stenoses or two grafts to the LAD and diagonal even though both are part of a single major vessel).
Mitral Insufficiency	Is there evidence of regurgitation: 0 = none, 1 = trivial, 2 = mild, 3 = moderate, 4 = severe	Mitral insufficiency (or regurgitation) should be determined by (in order of preference) either the echocardiogram or the left ventriculogram. The preferred order for MR favors echocardiogram over left ventriculogram; this is the opposite of the preferred order for ejection fraction. However, either method is adequate and it is not necessary to obtain an echocardiogram in patients already having ventriculograms. If a range of MR is given, enter the higher value (e.g. for "2 to 3" enter "3"). Transesophageal echocardiograms (TEE's) done during surgery should not be used as a source for either MR or EF, because operative hemodynamic conditions can artifactually alter both.
Cross Clamp Time	Minutes	
Perfusion Time	Minutes	

APPENDIX C: DEFINITIONS AND INSTRUCTIONS FOR CCMRP DATA SUBMISSIONS

Table C-1: Definitions and Instructions for CCMRP Data Submissions (cont.)

Data Elements	STS Definitions	CCMRP Comments, Modifications, and Examples
Internal Mammary Artery (IMA) used	yes/no	
Cardioplegia	yes/no	
Date of Discharge		
Patient Status at Discharge		Note for STS users: CCMRP will collect the data element “Mortality (yes/no)”
Date of Death	mm-dd-yy	If known

APPENDIX D: CCMRP QUARTERLY HOSPITAL SUBMISSIONS (1997-1999)

Table D-1: CCMRP Quarterly Hospital Submissions (1997-1999)

Hospital Name	Report Period	1997				1998				1999				Total Analyzed
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Alta Bates Medical Center	Y97Q1-Y99Q4	37	40	42	33	27	33	34	30	23	22	28	23	372
Alvarado Hospital Medical Center	Y97Q1-Y99Q4	42	34	35	33	35	48	33	37	42	42	30	34	445
CA Pacific Medical Center - Pacific Campus	Y98Q1-Y99Q4	-	-	-	-	44	40	47	45	46	37	41	48	348
Cedars-Sinai Medical Center	Y97Q1-Y99Q4	129	116	114	88	114	117	95	95	90	78	88	96	1,220
Community Memorial Hospital of San Buenaventura	Y98Q1-Y99Q4	-	-	-	-	52	51	42	57	47	53	34	54	390
Dameron Hospital	Y98Q1-Y99Q4	-	-	-	-	21	30	25	31	38	24	26	21	216
Daniel Freeman Memorial Hospital	Y98Q1-Y99Q4	-	-	-	-	56	39	37	41	47	36	37	36	329
Desert Regional Medical Center	Y98Q1-Y99Q4	-	-	-	-	39	23	30	30	24	41	34	34	255
Doctor's Medical Center - Modesto	Y98Q1-Y99Q4	-	-	-	-	108	123	109	111	133	129	126	120	959
Doctor's Medical Center - San Pablo	Y97Q1-Y99Q4	26	10	18	19	25	32	19	20	23	18	24	16	250
Dominican Hospital	Y97Q1-Y99Q4	39	31	29	37	40	32	28	36	45	35	36	44	432
El Camino Hospital	Y98Q3-Y99Q4	-	-	-	-	-	-	25	24	29	25	29	25	157
Encino Tarzana Regional Medical Center	Y98Q1-Y99Q4	-	-	-	-	38	46	32	29	53	41	34	44	317

APPENDIX D: CCMRP QUARTERLY HOSPITAL SUBMISSIONS (1997-1999)

Table D-1: CCMRP Quarterly Hospital Submissions (1997-1999) (cont.)

Hospital Name	Report Period	1997				1998				1999				Total Analyzed
Glendale Adventist Medical Center - Wilson Terrace[1]	Y98Q4-Y99Q4	-	-	-	-	-	-	-	57	67	64	61	75	324
Glendale Memorial Hospital and Health Center	Y98Q1-Y99Q4	-	-	-	-	60	60	47	56	39	55	40	44	401
Granada Hills Community Hospital	Y97Q1-Y99Q4	15	11	20	21	19	23	22	10	19	17	18	18	213
Green Hospital of Scripps Clinic	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	47	56	56	70	229
Heart Hospital of the Desert	Y97Q4-Y99Q4	-	-	-	18	36	32	22	23	27	17	24	19	218
Hoag Memorial Hospital Presbyterian	Y97Q1-Y99Q4	67	61	58	63	71	64	67	45	54	60	77	64	751
John Muir Medical Center	Y98Q1-Y99Q4	-	-	-	-	38	27	31	32	40	32	26	28	254
Kaiser Foundation Hospital - Los Angeles	Y97Q1-Y99Q4	256	237	261	259	287	293	341	368	412	411	384	390	3,899
Kaiser Foundation Hospital - San Francisco	Y98Q1-Y99Q4	-	-	-	-	178	241	280	293	291	312	349	330	2,274
Kaweah Delta Hospital	Y97Q1-Y99Q4	73	66	63	61	65	82	82	70	99	110	105	88	964
Loma Linda University Medical Center	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	106	86	106	104	402
Long Beach Memorial Medical Center	Y98Q1-Y99Q4	-	-	-	-	95	99	94	90	94	96	80	93	741

APPENDIX D: CCMRP QUARTERLY HOSPITAL SUBMISSIONS (1997-1999)

Table D-1: CCMRP Quarterly Hospital Submissions (1997-1999) (cont.)

Hospital Name	Report Period	1997				1998				1999				Total Analyzed
Marin General Hospital	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	18	10	23	16	67
Memorial Medical Center of Modesto	Y97Q1-Y99Q4	67	65	63	79	66	71	64	75	72	93	66	68	849
Mercy Medical Center - Redding	Y98Q3-Y99Q4	-	-	-	-	-	-	59	53	44	61	55	56	328
Methodist Hospital of Southern California	Y97Q1-Y99Q4	65	46	55	49	63	53	58	39	56	70	69	87	710
Mission Hospital and Regional Medical Center	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	57	82	47	51	237
Palomar Medical Center	Y97Q1-Y99Q4	52	38	41	39	46	44	42	47	36	25	22	32	464
Presbyterian Intercommunity Hospital	Y98Q1-Y99Q4	-	-	-	-	31	33	31	21	19	20	14	20	189
Providence Holy Cross Medical Center	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	23	34	19	30	106
Providence St. Joseph Medical Center	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	56	42	34	60	192
Redding Medical Center	Y97Q1-Y99Q4	140	157	113	129	157	114	107	120	139	143	100	136	1,555
Saddleback Memorial Medical Center	Y98Q1-Y99Q4	-	-	-	-	39	57	40	39	34	35	28	35	307
Salinas Valley Memorial Hospital	Y98Q3-Y99Q4	-	-	-	-	-	-	63	72	77	78	82	86	458

APPENDIX D: CCMRP QUARTERLY HOSPITAL SUBMISSIONS (1997-1999)

Table D-1: CCMRP Quarterly Hospital Submissions (1997-1999) (cont.)

Hospital Name	Report Period	1997				1998				1999				Total Analyzed
San Antonio Community Hospital	Y98Q1-Y99Q4	-	-	-	-	36	28	32	27	30	27	29	34	243
San Jose Medical Center	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	20	17	15	14	66
Santa Barbara Cottage Hospital	Y98Q1-Y99Q4	-	-	-	-	81	73	57	50	49	92	57	74	533
Santa Monica - UCLA Hospital Med Ctr	Y98Q1-Y99Q4	-	-	-	-	15	12	7	11	17	14	13	14	103
Santa Rosa Memorial Hospital	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	46	50	40	51	187
Scripps Memorial Hospital – La Jolla	Y97Q1-Y99Q4	90	79	76	82	83	92	78	94	114	97	91	122	1,098
Scripps Mercy	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	57	84	56	59	256
Sequoia Hospital	Y97Q1-Y99Q4	50	68	67	55	73	75	51	44	64	69	47	54	717
Seton Medical Center - Heart Institute	Y97Q1-Y99Q4	185	190	167	152	156	131	125	143	131	132	113	105	1,730
Sharp Chula Vista Medical Center	Y97Q1-Y99Q4	70	82	64	53	81	59	61	61	82	76	72	60	821
Sharp Grossmont Hospital	Y98Q1-Y99Q4	-	-	-	-	25	34	30	44	47	30	37	34	281
Sharp Memorial Hospital	Y98Q1-Y99Q4	-	-	-	-	67	84	63	90	79	65	52	55	555
St. Bernardine Medical Center	Y98Q2-Y99Q4	-	-	-	-	-	149	123	133	144	137	152	124	962
St. Francis Medical Center	Y98Q2-Y99Q4						21	22	19	16	29	28	23	158
St. Helena Hospital	Y97Q1-Y99Q4	43	46	42	40	61	60	70	57	52	77	60	72	680

APPENDIX D: CCMRP QUARTERLY HOSPITAL SUBMISSIONS (1997-1999)

Table D-1: CCMRP Quarterly Hospital Submissions (1997-1999) (cont.)

Hospital Name	Report Period	1997				1998				1999				Total Analyzed
St. John's Hospital and Health Center	Y97Q1-Y99Q4	33	35	28	33	34	39	34	19	43	35	30	40	403
St. Joseph Hospital - Orange	Y98Q1-Y99Q4	-	-	-	-	73	72	73	75	67	86	72	88	606
St. Joseph's Medical Center of Stockton	Y97Q1-Y99Q4	63	99	73	82	79	84	73	57	69	70	57	73	879
St. Jude Medical Center	Y98Q1-Y99Q4	-	-	-	-	41	41	62	60	74	85	64	70	497
St. Mary's Hospital and Medical Center	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	146	149	135	123	553
St. Vincent Medical Center	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	58	87	77	60	282
Stanford University Hospital	Y98Q1-Y99Q4	-	-	-	-	61	94	54	60	58	48	51	64	490
Summit Medical Center	Y97Q1-Y99Q4	54	26	39	49	42	37	40	38	44	56	45	52	522
Sutter Memorial Hospital	Y97Q1-Y99Q4	221	218	192	209	188	184	152	170	172	191	128	132	2,157
The Hospital of the Good Samaritan - LA	Y99Q1-Y99Q4	-	-	-	-	-	-	-	-	174	171	164	140	649
Torrance Memorial Medical Center	Y97Q1-Y99Q4	54	45	43	56	56	45	39	63	57	55	48	42	603
Tri-City Medical Center	Y97Q1-Y99Q4	42	56	48	63	61	60	49	52	60	36	51	49	627
UC Irvine Medical Center	Y98Q1-Y99Q4	-	-	-	-	22	21	30	21	18	27	12	13	164
UCD Medical Center	Y98Q3-Y99Q4	-	-	-	-	-	-	28	31	34	50	45	40	228

APPENDIX D: CCMRP QUARTERLY HOSPITAL SUBMISSIONS (1997-1999)

Table D-1: CCMRP Quarterly Hospital Submissions (1997-1999) (cont.)

Hospital Name	Report Period	1997				1998				1999				Total Analyzed
Tri-City Medical Center	Y97Q1-Y99Q4	42	56	48	63	61	60	49	52	60	36	51	49	627
UC Irvine Medical Center	Y98Q1-Y99Q4	-	-	-	-	22	21	30	21	18	27	12	13	164
UCD Medical Center	Y98Q3-Y99Q4	-	-	-	-	-	-	28	31	34	50	45	40	228
UCLA Medical Center	Y98Q1-Y99Q4	-	-	-	-	55	58	37	40	48	46	52	31	367
UCSF Medical Center	Y98Q1-Y99Q4	-	-	-	-	39	42	34	26	30	30	34	40	275
USC University Hospital	Y97Q1-Y99Q4	23	18	16	18	18	14	26	11	24	30	22	29	249
Washington Hospital – Fremont	Y97Q1-Y99Q4	39	49	36	42	35	46	41	46	34	62	38	34	502

APPENDIX E: SAMPLE FORM FOR QUICK REVIEW DATA QUALITY CHECK

HOSPITAL

Thank you for submitting your CCMRP data.

A quick review of your data shows **XX** isolated CABGs were reported for the **X** quarter of 1999. We have identified the following potential problems in your data submission (checks indicate one or more records with the specified problem):

Missing data

- ☐ Date of Surgery
- ☐ Insurer
- ☐ Creatinine
- ☐ PVD
- ☐ Most Recent MI
- ☐ PTCA
- ☐ Angina
- ☐ Status (acuity)
- ☐ # Diseased Vessels
- ☐ IMA Used
- ☐ Date of Death
- ☐ Gender
- ☐ Patient Zip Code
- ☐ Hypertension
- ☐ CVD
- ☐ Prior # Heart Ops
- ☐ Interval (PTCA)
- ☐ Unstable Angina
- ☐ Ejection Fraction
- ☐ Mitral Insufficiency
- ☐ Cardioplegia
- ☐ Date of Birth
- ☐ Height
- ☐ Dialysis
- ☐ Arrhythmia
- ☐ Most Recent Op
- ☐ COPD
- ☐ NYHA
- ☐ EF Method
- ☐ Cross Clamp Time
- ☐ Date of Discharge
- ☐ Race/Ethnicity
- ☐ Weight
- ☐ Diabetes
- ☐ MI
- ☐ Prior # PTCAs
- ☐ CHF
- ☐ CCS
- ☐ Left Main Stenosis
- ☐ Perfusion Time
- ☐ Discharge Status

Logic problems

- ☐ Angina = “yes” (1) but no Unstable Angina reported
- ☐ MI = “yes” (1) but no MI Date reported
- ☐ Current PTCA = “yes” (1) but no Interval reported
- ☐ Angina = “no” (0) but CCS greater than II
- ☐ Creatinine greater than 6 but Dialysis = “no”
- ☐ Discharge date earlier than surgery date
- ☐ Ejection Fraction reported but no Method of Measurement is reported
- ☐ Angina = “no” (0) but Unstable Angina reported
- ☐ MI = “no” (0) but MI Date is reported
- ☐ Current PTCA = “no” (0) but Interval reported
- ☐ Unstable Angina = “unstable” but CCS less than III
- ☐ Discharge status = “Dead” but no date of death

Out of range values

- ☐ Ejection Fraction less than 10%
- ☐ Surgery Date prior to 1999
- ☐ Date of Birth later than 1981
- ☐ Creatinine Level greater than 14.9
- ☐ Discharge date prior to 1999

You may resubmit the data for this report period after the problems have been resolved, or wait and resubmit corrected data with the next quarter.

APPENDIX F: CCMRP SAMPLE DATA QUALITY REPORT

Univariate Comparison of Sample Hospital Data to All Data Submissions

HOSPITAL DATA SUMMARY REPORT - CCMRP 1999
Sample Hospital

Submissions in 1999:

	Hospital			California		
	Total	Duplicates	% Duplicated	Total	Duplicates	% Duplicated
Q1:	25	0	0	5,586	0	0
Q2:	30	0	0	5,835	2	0.03
Q3:	22	0	0	5,298	3	0.06
Q4:	30	0	0	5,448	1	0.02
All:	**107**	**0**	**0**	**22,166**	**6**	**0.03**

For all frequency distributions shown in the following tabulations, duplicate records were removed.

Status at Discharge:		
		California
Missing	0 (0.0%)	36 (0.2%)
Alive	101 (94.3%)	21,518 (97.1%)
Dead	6 (5.7%)	612 (2.8%)

Age:		
	Hospital	California
Missing	0 (0.0%)	1 (0.0%)
18 to 49		1,525 (6.9%)
50 to 59	19 (17.9%)	4,487 (20.2%)
60 to 69	40 (37.7%)	6,827 (30.8%)
70 to 79	34 (32.1%)	7,364 (33.2%)
80 or older	7 (6.6%)	1,962 (8.9%)

Sex:		
	Hospital	California
Missing	0 (0.0%)	11 (0.0%)
Female		6,006 (27.1%)
Male *	75 (70.8%)	16,149 (72.9%)

Race:		
	Hospital	California
Missing	0 (0.0%)	73 (0.3%)
Non-White	50 (46.2%)	5,590 (25.2%)
White *	57 (53.8%)	16,503 (74.5%)

Myocardial Infarction:		
	Hospital	California
Missing	0 (0.0%)	459 (2.1%)
None *	57 (53.8%)	11,327 (51.1%)
Less than 24 hrs.	0 (0.0%)	792 (3.6%)
1-6 days	10 (9.4%)	3,977 (17.9%)
7-20 days	13 (12.3%)	974 (4.4%)
21 days or more	26 (24.5%)	4,637 (20.9%)

Diseased Vessels:		
	Hospital	California
Missing	**2 (1.9%)**	300 (1.4%)
None	0 (0.0%)	164 (0.7%)
One *	4 (3.8%)	1,255 (5.7%)
Two	22 (20.8%)	4,130 (18.6%)
Three or more	78 (73.6%)	16,317 (73.6%)

Ejection Fraction:		
	Hospital	California
Missing	**23 (21.7%)**	1,381 (6.2%)
<20%	4 (3.8%)	180 (0.8%)
20% to 29%	10 (9.4%)	1,004 (4.5%)
30% to 39%	11 (10.4%)	1,961 (8.8%)
40% to 49%	19 (17.9%)	3,688 (16.6%)
50% or more *	39 (36.8%)	13,952 (62.9%)

APPENDIX F: CCMRP SAMPLE DATA QUALITY REPORT

Univariate Comparison of Sample Hospital Data to All Data Submissions

HOSPITAL DATA SUMMARY REPORT - CCMRP 1999
Sample Hospital

Hypertension:		
	Hospital	California
Missing	0 (0.0%)	79 (0.4%)
No *	43 (40.6%)	6,770 (30.5%)
Yes	63 (59.4%)	15,317 (69.1%)

COPD:		
	Hospital	California
Missing	0 (0.0%)	325 (1.5%)
No *	99 (93.4%)	18,902 (85.3%)
Yes	7 (6.6%)	2,939 (13.3%)

Angina:		
	Hospital	California
Missing	0 (0.0%)	98 (0.4%)
None	77 (72.6%)	2,707 (12.2%)
Stable *	24 (22.6%)	7,111 (32.1%)
Unstable	5 (4.7%)	12,250 (55.3%)

Dialysis:		
	Hospital	California
Missing	0 (0.0%)	938 (4.2%)
No *	104 (98.1%)	20,762 (93.7%)
Yes	2 (1.9%)	466 (2.1%)

Diabetes:		
	Hospital	California
Missing	0 (0.0%)	93 (0.4%)
No *		14,478 (65.3%)
Yes	37 (34.9%)	7,595 (34.3%)

PTCA:		
	Hospital	California
Missing	**89 (84.0%)**	8,554 (38.6)
No *	1 (0.9%)	12,904 (58.2%)
Yes	16 (15.1%)	708 (3.2%)

Creatinine:		
	Hospital	California
Missing	**3 (2.8%)**	3,641 (16.4%)
<2.0 *	97 (91.5 %)	17,468 (78.8 %)
2.0 to 3.9	5 (4.7%)	675 (3.0%)
4.0 to 7.9	0 (0.0%)	258 (1.2%)
8.0 or more	1 (0.9%)	124 (0.6%)

Cerebrovascular Disease:		
	Hospital	California
Missing	0 (0.0%)	130 (0.6%)
No *	72 (67.9%)	19,382 (87.4%)
Yes	34 (32.1%)	2,654 (12.0%)

Mitral Insufficiency:		
	Hospital	California
Missing	0 (0.0%)	8,095 (36.5%)
None *	49 (46.2%)	11,755 (53.0%)
Trivial	19 (17.9%)	954 (4.3%)
Mild	30 (28.3%)	1,000 (4.5%)
Moderate	3 (2.8%)	298 (1.3%)
Severe	5 (4.7%)	64 (0.3%)

Acuity:		
	Hospital	California
Missing	0 (0.0%)	25 (0.1%)
Elective *	90 (84.9%)	10,975 (49.5%)
Urgent	14 (13.2%)	9,602 (43.3%)
Emergent	2 (1.9%)	1,425 (6.4%)
Salvage	0 (0.0%)	139 (0.6%)

Left Main Stenosis:		
	Hospital	California
Missing	**93 (87.7%)**	5,597 (25.3%)
50% or less *	2 (1.9%)	11,968 (54.0%)
51% to 70%	4 (3.8%)	2,404 (10.8%)
71% to 90%	7 (6.6%)	1,602 (7.2%)
91% or more	0 (0.0%)	595 (2.7%)

APPENDIX F: CCMRP SAMPLE DATA QUALITY REPORT

Univariate Comparison of Sample Hospital Data to All Data Submissions

HOSPITAL DATA SUMMARY REPORT - CCMRP 1999
Sample Hospital

Peripheral Vascular Disease:		
	Hospital	California
Missing	0 (0.0%)	118 (0.5%)
No *	88 (83.0%)	18,994 (85.7%)
Yes	18 (17.0%)	3,054 (13.8%)

Ventricular Arrhythmia:		
	Hospital	California
Missing		2,496 (11.3%)
No *	105 (99.1%)	18,638 (84.1%)
Yes	1 (0.9%)	1,032 (4.7%)

Number of Operations:		
	Hospital	California
Missing	0 (0.0%)	3,902 (17.6%)
First *	85 (80.2%)	16,717 (75.4%)
Second	16 (15.1%)	1,390 (6.3%)
Third	5 (4.7%)	144 (0.6%)
Four+	0 (0.0%)	13 (0.1%)

CCS Class:		
	Hospital	California
Missing	**2 (1.9%)**	699 (3.2%)
I	68 (64.2%)	2,475 (11.2%)
II	20 (18.9%)	3,748 (16.9%)
III *	6 (5.7%)	8,403 (37.9%)
IV	10 (9.4%)	6,841 (30.9%)

NYHA Class:		
	Hospital	California
Missing	**3 (2.8%)**	596 (2.7%)
I *	22 (20.8%)	10,264 (46.3%)
II	46 (43.4%)	3,364 (15.2%)
III	18 (17.0%)	4,979 (22.5%)
IV	17 (16.0%)	2,963 (13.4%)

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Notes: 1. Per default, for analytic purposes missing values will be assigned to the starred category.

2. If greater than 0, the number and percent of missing values for a variable is bolded.

APPENDIX F: CCMRP SAMPLE DATA QUALITY REPORT

Patient-Level Report

California CABG Mortality Reporting Program - Year 1999
Hospital ID=123456 Example Hospital

Patient Height Out of Range or Not Reported in Centimeters

Date of Surgery	Date of Birth	Sex	Race/Ethnicity	Date of Discharge	Status at Discharge	Wt. Kilo	Ht. CM
7/16/2000	6/16/19XX	F	Caucasian	7/23/2000	ALIVE	88.90	118.8
7/24/2000	7/15/19XX	F	Other	7/29/2000	ALIVE		
9/5/2000	7/28/19XX	M	Caucasian	9/10/2000		112.4	

PTCA/Atherectomy Indicated but No PTCA to Surgery Time Interval Given

Date of Surgery	Date of Birth	Sex	Race/Ethnicity	Date of Discharge	Status at Discharge	PTCA/Atherectomy	PTCA to Surgery Time
7/31/2000	10/16/19XX	F	Caucasian	8/7/2000	ALIVE	1	
8/20/2000	2/4/19XX	F	Black	8/24/2000	ALIVE	1	

Value Missing for Priority of Operation (ACUITY: Elective/Urgent/Emergent/Salvage)

Date of Surgery	Date of Birth	Sex	Race/Ethnicity	Date of Discharge	Status at Discharge	Operation Acuity
8/30/2000	2/23/19XX	F	Caucasian	9/2/2000	ALIVE	
9/11/2000	11/21/19XX	F	Caucasian	9/14/2000	ALIVE	
12/20/2000	9/21/19XX	M	Caucasian	12/26/2000	ALIVE	

Creatinine Level Value >=7.0 Recorded but No Record of Dialysis or Dialysis Recorded NO

Date of Surgery	Date of Birth	Sex	Race/ Ethnicity	Date of Discharge	Status at Discharge	Dialysis	Creatinine
6/8/2000	11/18/19XX	M	3	6/13/2000	ALIVE	No	7.9

NO PTCA/Atherectomy Indicated but PTCA to Surgery Time Interval Given

Date of Surgery	Date of Birth	Sex	Race/ Ethnicity	Date of Discharge	Status at Discharge	PTCA to Surgery Time	PTCA/Atherectomy
8/1/2000	11/25/19XX	M	Asian	8/5/2000	ALIVE	<=6 hrs	

APPENDIX G: UNIVARIATE DATA SUMMARIES

The table in this section summarizes hospital coding practices for the factors that were included in the risk-adjustment models.

The row titled “Weighted Average” refers to data for all hospitals combined.

The shading of a cell in the body of the table corresponds to the risk factor’s value relative to all other California hospitals included in the analysis. No shading indicates that the risk factor’s value is at or below the lower tercile (33rd percentile), a light gray shading indicates that the risk factor’s value is between the lower tercile and the upper tercile (67th percentile), and the dark gray shading indicates that the risk factor’s value exceeds the upper tercile.

Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	Status	Gender	Race	Age	Hypertension	Dialysis	Diabetes	PVD
	Dead	Female	Non-White	>=70	Yes	Yes	Yes	Yes
Weighted Average	2.8%	27.0%	24.9%	42.2%	69.4%	2.0%	34.3%	13.5%
Alta Bates Medical Center	4.2%	21.9%	29.2%	43.8%	64.6%	6.3%	34.4%	17.7%
Alvarado Hospital Medical Center	4.1%	29.1%	25.0%	49.3%	72.3%	1.4%	30.4%	11.5%
California Pacific Medical Center - Pacific Campus	2.3%	28.5%	41.3%	51.2%	67.4%	0.6%	29.7%	17.4%
Cedars-Sinai Medical Center	2.6%	26.1%	16.2%	50.9%	62.5%	0.9%	31.8%	19.3%
Community Memorial Hospital of San Buenaventura	2.1%	27.1%	17.6%	47.3%	65.4%	5.3%	34.6%	2.7%
Dameron Hospital	5.5%	36.7%	47.7%	38.5%	66.1%	5.5%	45.0%	19.3%
Daniel Freeman Memorial Hospital	3.8%	36.5%	44.2%	50.0%	80.8%	2.6%	34.6%	14.7%
Desert Regional Medical Center	6.8%	25.6%	15.0%	47.4%	69.9%	1.5%	27.8%	14.3%
Doctor's Medical Center - Modesto	2.4%	29.1%	18.1%	38.6%	68.1%	1.0%	32.1%	7.1%
Doctor's Medical Center - San Pablo	0.0%	33.3%	44.4%	39.5%	66.7%	0.0%	32.1%	18.5%
Dominican Hospital	2.5%	30.0%	9.4%	43.8%	61.9%	0.0%	26.3%	15.0%
El Camino Hospital	2.8%	23.1%	25.0%	41.7%	76.9%	1.9%	32.4%	19.4%
Encino Tarzana Regional Medical Center	4.1%	30.2%	7.0%	51.7%	62.8%	2.3%	29.7%	11.6%
Glendale Adventist Medical Center - Wilson Terrace	4.1%	34.5%	24.3%	49.4%	74.2%	4.1%	34.1%	6.7%
Glendale Memorial Hospital and Health Center	3.9%	29.8%	27.0%	46.6%	76.4%	1.7%	36.5%	19.1%
Granada Hills Community Hospital	2.8%	29.2%	50.0%	33.3%	68.1%	2.8%	30.6%	11.1%
Green Hospital of Scripps Clinic	1.7%	21.8%	11.8%	51.1%	73.8%	0.4%	19.2%	13.5%
Heart Hospital of the Desert	0.0%	19.5%	4.6%	56.3%	82.8%	4.6%	27.6%	24.1%
Hoag Memorial Hospital Presbyterian	3.5%	21.6%	9.8%	45.1%	64.3%	2.4%	25.5%	24.7%
John Muir Medical Center	4.8%	27.0%	7.9%	52.4%	74.6%	0.0%	26.2%	22.2%
Kaiser Foundation Hospital - Los Angeles	1.4%	22.8%	35.0%	31.7%	74.0%	1.8%	39.3%	9.3%
Kaiser Foundation Hospital - San Francisco	1.8%	22.2%	28.2%	34.0%	67.6%	1.7%	37.1%	12.7%
Kaweah Delta Hospital	2.5%	33.8%	28.6%	41.3%	74.1%	2.5%	44.5%	14.2%
Loma Linda University Medical Center	1.5%	23.4%	17.4%	42.3%	69.9%	1.7%	35.8%	23.9%
Long Beach Memorial Medical Center	3.6%	24.5%	24.2%	43.3%	76.0%	1.1%	33.3%	17.6%
Marin General Hospital	6.0%	19.4%	9.0%	40.3%	53.7%	0.0%	25.4%	14.9%
Memorial Medical Center of Modesto	3.3%	29.4%	10.7%	34.8%	67.9%	2.3%	34.4%	10.4%

upper tercile. middle tercile. lower tercile.

Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	Status	Gender	Race	Age	Hypertension	Dialysis	Diabetes	PVD
	Dead	Female	Non-White	>=70	Yes	Yes	Yes	Yes
Weighted Average	2.8%	27.0%	24.9%	42.2%	69.4%	2.0%	34.3%	13.5%
Mercy Medical Center - Redding	3.7%	29.6%	2.3%	42.6%	68.1%	0.9%	32.9%	16.2%
Methodist Hospital of Southern California	1.4%	25.5%	27.3%	48.6%	69.9%	0.7%	34.0%	13.1%
Mission Hospital and Regional Medical Center	2.5%	19.0%	10.5%	39.7%	63.7%	0.4%	28.7%	4.2%
Palomar Medical Center	4.3%	26.1%	10.4%	54.8%	72.2%	0.0%	27.8%	13.9%
Presbyterian Intercommunity Hospital	1.4%	26.0%	28.8%	54.8%	71.2%	2.7%	28.8%	2.7%
Providence Holy Cross Medical Center	1.9%	23.6%	38.7%	35.8%	84.0%	3.8%	35.8%	8.5%
Providence St. Joseph Medical Center	2.1%	26.0%	16.1%	41.7%	58.3%	2.6%	25.5%	12.5%
Redding Medical Center	1.2%	25.1%	2.9%	43.6%	63.9%	0.4%	22.2%	11.2%
Saddleback Memorial Medical Center	6.1%	27.3%	6.8%	62.1%	81.1%	0.0%	85.6%	17.4%
Salinas Valley Memorial Hospital	2.5%	39.3%	31.9%	45.5%	67.8%	2.5%	42.7%	11.5%
San Antonio Community Hospital	2.5%	27.5%	29.2%	35.8%	83.3%	0.8%	32.5%	15.8%
San Jose Medical Center	3.0%	27.3%	54.5%	30.3%	68.2%	4.5%	37.9%	3.0%
Santa Barbara Cottage Hospital	2.2%	25.4%	16.5%	49.6%	62.9%	0.4%	29.0%	9.6%
Santa Monica - UCLA Hospital Medical Center	3.4%	31.0%	22.4%	67.2%	56.9%	1.7%	24.1%	20.7%
Santa Rosa Memorial Hospital	4.8%	21.9%	5.9%	47.1%	71.7%	2.1%	20.9%	11.2%
Scripps Memorial Hospital - La Jolla	2.6%	23.6%	16.7%	44.3%	71.0%	2.4%	34.2%	19.6%
Scripps Mercy	6.3%	34.0%	32.8%	46.9%	78.9%	3.5%	35.9%	12.9%
Sequoia Hospital	3.0%	26.1%	15.0%	44.0%	76.5%	1.7%	30.3%	20.9%
Seton Medical Center - Heart Institute	2.5%	29.7%	42.0%	43.5%	75.3%	1.2%	37.6%	8.7%
Sharp Chula Vista Medical Center	2.1%	35.9%	63.8%	41.4%	79.3%	5.5%	46.9%	14.1%
Sharp Grossmont Hospital	2.0%	39.2%	16.9%	50.7%	83.1%	1.4%	32.4%	12.2%
Sharp Memorial Hospital	4.8%	23.5%	28.3%	43.0%	72.9%	2.4%	35.1%	17.1%
St. Bernardine Medical Center	2.5%	30.7%	12.2%	48.3%	63.7%	0.7%	32.3%	9.9%
St rancis Medical Center	1.0%	41.7%	86.5%	36.5%	80.2%	6.3%	50.0%	15.6%
St. Helena Hospital	3.8%	41.0%	13.0%	50.2%	73.6%	2.7%	31.0%	22.2%
St. John's Hospital and Health Center - Santa Monica	4.1%	23.6%	12.8%	48.0%	58.1%	1.4%	29.1%	22.3%
St. Joseph Hospital – Orange	1.3%	22.7%	11.8%	39.6%	68.1%	0.3%	28.8%	13.7%

upper tercile. middle tercile. lower tercile.

Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	Status	Gender	Race	Age	Hypertension	Dialysis	Diabetes	PVD
	Dead	Female	Non-White	>=70	Yes	Yes	Yes	Yes
Weighted Average	2.8%	27.0%	24.9%	42.2%	69.4%	2.0%	34.3%	13.5%
St. Joseph's Medical Center of Stockton	2.6%	28.3%	27.9%	42.0%	76.2%	2.6%	38.7%	16.0%
St. Jude Medical Center	3.4%	22.2%	16.0%	37.5%	63.8%	1.0%	30.7%	7.8%
St. Mary's Hospital and Medical Center - San Francisco	1.8%	28.6%	37.1%	39.6%	64.0%	4.0%	34.5%	9.0%
St. Vincent Medical Center	3.2%	25.5%	58.2%	50.4%	74.1%	7.1%	41.5%	8.5%
Stanford University Hospital	3.2%	20.8%	28.1%	47.1%	64.3%	1.4%	31.7%	13.1%
Summit Medical Center	3.6%	32.0%	39.6%	44.7%	71.1%	1.5%	39.1%	19.3%
Sutter Memorial Hospital	1.9%	27.9%	10.1%	42.9%	69.7%	1.9%	27.9%	16.2%
The Hospital of the Good Samaritan - LA	3.9%	28.4%	48.4%	42.1%	66.6%	4.5%	43.0%	16.3%
Torrance Memorial Medical Center	3.5%	27.7%	34.2%	37.6%	73.3%	1.0%	37.6%	9.4%
Tri-City Medical Center	2.0%	20.9%	11.7%	56.1%	51.0%	1.5%	23.0%	15.3%
UCD Medical Center	2.4%	24.9%	27.2%	30.8%	88.2%	0.6%	32.0%	16.6%
UC Irvine Medical Center	4.3%	24.3%	48.6%	28.6%	85.7%	1.4%	45.7%	21.4%
UCLA Medical Center	4.5%	19.2%	24.3%	46.3%	56.5%	1.1%	29.4%	8.5%
UCSF Medical Center	3.7%	27.6%	56.7%	28.4%	79.9%	3.0%	43.3%	14.2%
USC University Hospital	5.7%	29.5%	46.7%	38.1%	61.9%	2.9%	34.3%	17.1%
Washington Hospital – Fremont	7.7%	31.5%	50.6%	42.3%	77.4%	1.8%	47.0%	23.2%

upper tercile. middle tercile. lower tercile.

Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	CVD Yes	Ventr Arrth Yes	COPD Yes	PTCA Yes	# Prior Ops op	MI 0-7 Days	Angina None	CHF Yes
Weighted Average	12.2%	4.2%	13.0%	10.0%	0.8%	21.4%	11.7%	18.2%
Alta Bates Medical Center	13.5%	6.3%	10.4%	24.0%	0.0%	8.3%	6.3%	21.9%
Alvarado Hospital Medical Center	5.4%	6.1%	11.5%	7.4%	2.0%	10.1%	39.2%	60.8%
California Pacific Medical Center - Pacific Campus	12.2%	4.1%	15.7%	22.1%	0.0%	22.1%	8.7%	29.1%
Cedars-Sinai Medical Center	12.2%	2.8%	11.4%	4.0%	1.1%	6.0%	14.8%	19.3%
Community Memorial Hospital of San Buenaventura	10.6%	5.3%	4.3%	22.3%	1.1%	16.5%	24.5%	11.2%
Dameron Hospital	13.8%	0.0%	29.4%	3.7%	2.8%	12.8%	0.9%	13.8%
Daniel Freeman Memorial Hospital	7.7%	6.4%	10.3%	7.1%	0.6%	20.5%	10.3%	19.2%
Desert Regional Medical Center	13.5%	3.0%	10.5%	4.5%	0.8%	27.1%	22.6%	14.3%
Doctor's Medical Center - Modesto	3.3%	4.5%	15.9%	4.1%	0.8%	19.5%	11.4%	10.2%
Doctor's Medical Center - San Pablo	16.0%	3.7%	6.2%	18.5%	0.0%	25.9%	6.2%	14.8%
Dominican Hospital	8.8%	1.3%	12.5%	10.0%	0.0%	21.9%	12.5%	20.6%
El Camino Hospital	11.1%	7.4%	13.0%	3.7%	0.0%	12.0%	8.3%	23.1%
Encino Tarzana Regional Medical Center	9.3%	2.9%	14.5%	24.4%	0.6%	22.7%	11.0%	20.3%
Glendale Adventist Medical Center - Wilson Terrace	6.0%	2.6%	12.4%	7.5%	0.0%	9.7%	30.0%	19.5%
Glendale Memorial Hospital and Health Center	7.3%	7.3%	16.3%	6.7%	0.0%	26.4%	14.0%	28.7%
Granada Hills Community Hospital	6.9%	1.4%	4.2%	1.4%	0.0%	13.9%	16.7%	18.1%
Green Hospital of Scripps Clinic	9.6%	1.3%	5.7%	10.0%	0.4%	7.0%	14.4%	5.7%
Heart Hospital of the Desert	23.0%	6.9%	26.4%	4.6%	0.0%	8.0%	2.3%	24.1%
Hoag Memorial Hospital Presbyterian	25.9%	14.1%	11.8%	12.9%	0.0%	22.4%	14.1%	25.1%
John Muir Medical Center	20.6%	5.6%	11.9%	11.1%	1.6%	26.2%	17.5%	20.6%
Kaiser Foundation Hospital - Los Angeles	14.0%	2.6%	9.9%	10.9%	0.3%	27.4%	5.0%	18.8%
Kaiser Foundation Hospital - San Francisco	9.2%	4.1%	7.3%	2.3%	0.5%	17.6%	14.0%	14.0%
Kaweah Delta Hospital	18.2%	2.7%	24.6%	5.2%	0.7%	23.1%	3.0%	22.6%
Loma Linda University Medical Center	21.9%	3.0%	22.9%	2.5%	1.7%	24.4%	6.2%	18.7%
Long Beach Memorial Medical Center	12.9%	5.0%	14.9%	22.0%	1.1%	24.2%	9.4%	23.7%
Marin General Hospital	11.9%	1.5%	11.9%	0.0%	1.5%	10.4%	22.4%	14.9%
Memorial Medical Center of Modesto	11.0%	5.7%	11.7%	8.7%	0.7%	20.1%	8.4%	20.7%

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Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	CVD Yes	Ventr Arrth Yes	COPD Yes	PTCA Yes	# Prior Ops op	MI 0-7 Days	Angina None	CHF Yes
Weighted Average	12.2%	4.2%	13.0%	10.0%	0.8%	21.4%	11.7%	18.2%
Mercy Medical Center – Redding	13.4%	2.3%	25.5%	4.2%	0.9%	27.3%	10.6%	13.4%
Methodist Hospital of Southern California	9.2%	1.1%	7.4%	20.9%	0.0%	17.0%	40.1%	8.5%
Mission Hospital and Regional Medical Center	8.9%	0.8%	14.8%	5.1%	0.8%	21.5%	3.4%	24.5%
Palomar Medical Center	12.2%	10.4%	5.2%	19.1%	0.0%	25.2%	5.2%	17.4%
Presbyterian Intercommunity Hospital	2.7%	1.4%	17.8%	5.5%	0.0%	26.0%	0.0%	19.2%
Providence Holy Cross Medical Center	4.7%	5.7%	11.3%	4.7%	0.0%	31.1%	0.0%	30.2%
Providence St. Joseph Medical Center	10.9%	4.2%	6.3%	5.2%	0.5%	22.4%	12.0%	14.1%
Redding Medical Center	13.3%	1.0%	20.8%	6.2%	0.8%	13.9%	16.2%	7.5%
Saddleback Memorial Medical Center	11.4%	7.6%	36.4%	11.4%	0.0%	31.1%	6.8%	24.2%
Salinas Valley Memorial Hospital	11.8%	2.2%	7.4%	2.8%	0.6%	18.9%	20.1%	16.4%
San Antonio Community Hospital	10.0%	15.0%	53.3%	7.5%	1.7%	32.5%	0.8%	28.3%
San Jose Medical Center	9.1%	10.6%	6.1%	33.3%	0.0%	10.6%	18.2%	19.7%
Santa Barbara Cottage Hospital	8.5%	5.9%	9.2%	26.8%	0.0%	18.8%	16.5%	21.7%
Santa Monica - UCLA Hospital Medical Center	17.2%	8.6%	10.3%	89.7%	1.7%	22.4%	29.3%	13.8%
Santa Rosa Memorial Hospital	11.8%	8.0%	17.1%	6.4%	0.5%	34.8%	6.4%	17.6%
Scripps Memorial Hospital - La Jolla	16.3%	7.3%	18.2%	22.6%	0.2%	26.7%	4.7%	23.6%
Scripps Mercy	3.5%	4.3%	15.6%	2.3%	1.2%	33.2%	3.1%	21.9%
Sequoia Hospital	21.8%	10.3%	13.7%	35.0%	4.3%	9.0%	4.3%	22.6%
Seton Medical Center - Heart Institute	16.2%	12.1%	9.1%	17.0%	0.4%	16.0%	22.9%	11.2%
Sharp Chula Vista Medical Center	10.3%	3.8%	17.6%	1.0%	1.0%	27.9%	2.4%	27.9%
Sharp Grossmont Hospital	14.2%	2.0%	10.8%	2.7%	0.7%	31.1%	17.6%	25.7%
Sharp Memorial Hospital	17.5%	1.6%	10.8%	1.2%	1.2%	18.3%	21.1%	19.9%
St. Bernardine Medical Center	9.9%	5.0%	18.1%	2.0%	0.4%	30.0%	10.1%	18.7%
St. Francis Medical Center	14.6%	1.0%	18.8%	3.1%	0.0%	19.8%	4.2%	21.9%
St. Helena Hospital	19.2%	3.1%	21.8%	2.3%	0.4%	17.2%	24.5%	16.9%
St. John's Hospital and Health Center - Santa Monica	13.5%	14.9%	8.8%	9.5%	0.7%	20.9%	25.7%	4.7%
St. Joseph Hospital - Orange	3.8%	4.2%	18.2%	5.8%	0.6%	16.3%	4.8%	16.0%

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Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	CVD	Ventr Arrth	COPD	PTCA	# Prior Ops	MI	Angina	CHF
	Yes	Yes	Yes	Yes	op	0-7 Days	None	Yes
Weighted Average	12.2%	4.2%	13.0%	10.0%	0.8%	21.4%	11.7%	18.2%
St. Joseph's Medical Center of Stockton	13.4%	1.5%	21.2%	29.0%	1.1%	22.3%	3.0%	21.9%
St. Jude Medical Center	6.5%	7.8%	9.9%	6.8%	0.3%	20.5%	9.2%	12.6%
St. Mary's Hospital and Medical Center - San Francisco	8.1%	4.3%	6.1%	0.7%	0.9%	25.9%	4.9%	17.7%
St. Vincent Medical Center	15.2%	1.8%	5.7%	3.2%	1.8%	13.8%	6.4%	20.2%
Stanford University Hospital	29.0%	3.2%	7.2%	4.1%		12.2%	19.0%	65.2%
Summit Medical Center	14.2%	3.6%	16.8%	25.4%	0.5%	21.8%	10.2%	22.8%
Sutter Memorial Hospital	18.3%	4.7%	11.1%	20.1%	1.3%	28.6%	6.4%	18.6%
The Hospital of the Good Samaritan - LA	8.9%	2.8%	8.3%	2.2%	0.6%	9.4%	10.0%	19.9%
Torrance Memorial Medical Center	11.9%	4.5%	5.0%	4.5%	3.0%	19.8%	8.4%	13.4%
Tri-City Medical Center	8.2%	4.6%	15.3%	5.6%	0.5%	17.9%	23.0%	13.3%
UCD Medical Center	10.7%	3.6%	23.7%	3.6%	1.2%	14.2%	0.6%	14.8%
UC Irvine Medical Center	15.7%	4.3%	24.3%	2.9%	1.4%	14.3%	5.7%	10.0%
UCLA Medical Center	11.3%	1.1%	2.3%	2.8%	2.8%	20.3%	14.7%	11.3%
UCSF Medical Center	9.7%	1.5%	6.0%	6.0%	0.0%	25.4%	3.0%	23.1%
USC University Hospital	31.4%	0.0%	7.6%	8.6%	4.8%	10.5%	51.4%	16.2%
Washington Hospital - Fremont	23.2%	10.7%	16.1%	34.5%	1.2%	26.2%	10.1%	33.9%

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Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	Acuity Emergent	LM Stenosis >70	CAD Triple+	Mitral Insufficiency Moderate or Severe	Creatinine >=2	EF <30
Weighted Average	6.2%	10.2%	73.6%	1.7%	4.8%	6.6%
Alta Bates Medical Center	8.3%	15.6%		0.0%	12.5%	3.1%
Alvarado Hospital Medical Center	6.8%	11.5%	81.8%	0.7%	2.0%	9.5%
California Pacific Medical Center - Pacific Campus	4.1%	11.6%	84.3%	1.2%	4.1%	7.6%
Cedars-Sinai Medical Center	4.5%	11.4%	52.0%	3.7%	4.0%	8.2%
Community Memorial Hospital of San Buenaventura	1.6%	6.9%	78.7%	2.1%	4.3%	5.9%
Dameron Hospital	8.3%	14.7%	61.5%	2.8%	10.1%	6.4%
Daniel Freeman Memorial Hospital	5.1%	4.5%	0.0%	0.0%	7.7%	6.4%
Desert Regional Medical Center	6.8%	9.8%	69.9%	0.8%	3.8%	3.0%
Doctor's Medical Center - Modesto	4.1%	7.5%	75.4%	0.2%	1.2%	4.7%
Doctor's Medical Center - San Pablo	6.2%	13.6%		1.2%	3.7%	8.6%
Dominican Hospital	7.5%	15.0%	57.5%	1.9%	1.9%	1.9%
El Camino Hospital	7.4%	9.3%		6.5%	1.9%	2.8%
Encino Tarzana Regional Medical Center	18.0%	4.7%	79.7%	1.2%	4.1%	7.0%
Glendale Adventist Medical Center - Wilson Terrace	3.4%	0.7%	82.0%	0.4%	7.5%	8.6%
Glendale Memorial Hospital and Health Center	9.0%	12.9%	84.3%	0.6%	8.4%	6.2%
Granada Hills Community Hospital	2.8%	11.1%	59.7%	1.4%	4.2%	2.8%
Green Hospital of Scripps Clinic	1.7%	0.0%	64.6%	0.9%	3.9%	4.4%
Heart Hospital of the Desert	3.4%	10.3%	54.0%	4.6%	4.6%	2.3%
Hoag Memorial Hospital Presbyterian	21.6%	11.4%	88.6%	2.4%	2.4%	3.5%
John Muir Medical Center	18.3%	15.1%	68.3%	11.1%	2.4%	6.3%
Kaiser Foundation Hospital - Los Angeles	2.0%	5.9%	77.3%	0.6%	3.9%	2.8%
Kaiser Foundation Hospital - San Francisco	2.1%	14.0%	85.0%	0.5%	4.9%	4.7%
Kaweah Delta Hospital	2.5%	11.4%	89.6%	1.5%	5.0%	7.7%
Loma Linda University Medical Center	5.0%	8.2%	71.4%	0.7%	3.7%	6.7%
Long Beach Memorial Medical Center	6.9%	9.6%	73.6%	1.1%	5.2%	6.3%
Marin General Hospital	3.0%	10.4%	52.2%	0.0%	3.0%	7.5%
Memorial Medical Center of Modesto	2.0%	7.4%	63.9%	3.0%	2.7%	6.0%

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Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	Acuity	LM Stenosis	CAD	Mitral Insufficiency	Creatinine	EF
	Emergent	>70	Triple+	Moderate or Severe	>=2	<30
Weighted Average	6.2%	10.2%	73.6%	1.7%	4.8%	6.6%
Mercy Medical Center - Redding	13.4%	7.9%	75.5%	6.0%	4.6%	5.1%
Methodist Hospital of Southern California	5.7%	16.0%	88.7%	0.4%	5.0%	4.6%
Mission Hospital and Regional Medical Center	1.7%	13.1%	84.0%	0.0%	1.7%	1.7%
Palomar Medical Center	4.3%	22.6%	80.0%	3.5%	1.7%	4.3%
Presbyterian Intercommunity Hospital	2.7%	11.0%	79.5%	1.4%	4.1%	5.5%
Providence Holy Cross Medical Center	8.5%	8.5%	88.7%	0.0%	5.7%	5.7%
Providence St. Joseph Medical Center	18.2%	12.5%	58.9%	1.6%	5.2%	7.8%
Redding Medical Center	4.2%	1.7%	64.5%	1.4%	0.8%	1.4%
Saddleback Memorial Medical Center	6.1%	17.4%	78.8%	0.8%	3.8%	5.3%
Salinas Valley Memorial Hospital	7.4%	14.9%	77.7%	2.8%	7.1%	5.9%
San Antonio Community Hospital	13.3%	5.8%	66.7%	0.0%	3.3%	5.0%
San Jose Medical Center	1.5%	33.3%	78.8%	1.5%	10.6%	6.1%
Santa Barbara Cottage Hospital	18.0%	16.9%	80.5%	0.4%	1.8%	7.0%
Santa Monica-UCLA Hospital Medical Center	13.8%	19.0%	41.4%	5.2%	6.9%	0.0%
Santa Rosa Memorial Hospital	15.0%	20.9%		0.0%	7.0%	5.3%
Scripps Memorial Hospital - La Jolla	5.2%	20.3%	66.3%	3.8%	4.2%	4.5%
Scripps Mercy	5.5%	0.0%	87.9%	3.5%	9.8%	5.1%
Sequoia Hospital	3.0%	12.8%	74.4%	3.8%	5.6%	
Seton Medical Center - Heart Institute	0.8%	8.3%	65.7%	0.0%	5.4%	
Sharp Chula Vista Medical Center	5.5%	9.0%	67.6%	0.3%	7.9%	2.8%
Sharp Grossmont Hospital	2.0%	12.2%	59.5%	5.4%	4.7%	2.7%
Sharp Memorial Hospital	4.0%	12.7%	64.1%	0.0%	6.0%	
St. Bernardine Medical Center	9.0%	3.1%	79.7%	2.0%	3.8%	6.6%
St. Francis Medical Center	13.5%	12.5%	77.1%	2.1%	7.3%	9.4%
St. Helena Hospital	9.2%		80.5%	0.8%	5.7%	1.1%
St. John's Hospital and Health Center - Santa Monica	12.8%	9.5%	68.2%	0.0%	4.1%	4.7%
St. Joseph Hospital – Orange	6.7%	5.4%	88.2%	0.3%	4.8%	4.2%

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Table G-1: Hospital Coding Practices of Data Elements in Risk-Adjustment Model

Hospital Name	Acuity	LM Stenosis	CAD	Mitral Insufficiency	Creatinine	EF
	Emergent	>70	Triple+	Moderate or Severe	>=2	<30
Weighted Average	6.2%	10.2%	73.6%	1.7%	4.8%	6.6%
St. Joseph's Medical Center of Stockton	4.1%	16.4%	65.1%	0.0%	8.6%	6.7%
St. Jude Medical Center	3.8%	15.4%	91.1%	1.7%	2.4%	3.8%
St. Mary's Hospital and Medical Center - San Francisco	5.1%	11.8%	70.7%	6.3%	4.5%	8.9%
St. Vincent Medical Center	4.6%	7.4%	65.6%	3.9%	7.4%	8.9%
Stanford University Hospital	4.1%	10.0%	67.4%	1.4%	5.4%	8.6%
Summit Medical Center	5.1%	16.8%	81.2%	3.0%	5.1%	7.6%
Sutter Memorial Hospital	6.9%	12.0%	75.3%	1.6%	5.6%	4.5%
The Hospital of the Good Samaritan - LA	14.3%	8.0%	76.7%	1.7%	8.9%	56.4%
Torrance Memorial Medical Center	11.4%	10.9%	74.3%	1.0%	4.0%	4.0%
Tri-City Medical Center	5.1%	10.2%	48.5%	1.0%	3.6%	3.1%
UCD Medical Center	8.9%	13.6%	69.2%	2.4%	4.7%	8.3%
UC Irvine Medical Center	2.9%	5.7%	88.6%		12.9%	14.3%
UCLA Medical Center	11.3%	10.2%	74.6%	2.8%	4.0%	6.2%
UCSF Medical Center	5.2%	16.4%	83.6%	2.2%	3.0%	4.5%
USC University Hospital	1.0%	10.5%	75.2%	7.6%	5.7%	11.4%
Washington Hospital – Fremont	12.5%	2.4%	79.8%	11.9%	7.7%	7.7%

upper tercile. middle tercile. lower tercile.

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